The American Journal of Surgery

THURSTON SCOTT WELTON, M.D., *Editor*

Associate Editors

BRADLEY L. COLEY, M.D. · ARNOLD S. JACKSON, M.D.

E. ERIC LARSON, M.D.

UROLOGY

THYROID SURGERY

GASTROINTESTINAL SURGERY

VASCULAR AND ORTHOPEDIC SURGERY

March 1948

VOLUME LXXV · NUMBER 3

FIFTY-SEVENTH YEAR OF PUBLICATION

EDITORIAL BOARD

The American Journal of Surgery

Editor THURSTON SCOTT WELTON, *New York*

Associate Editors BRADLEY L. COLEY, *New York* · ARNOLD S. JACKSON, *Madison* · E. ERIC LARSON, *Los Angeles*

ADVISORY BOARD

CARL BECK, *Bethesda, Md.*
CLAUDE S. BECK, *Cleveland*
GEORGE R. BRIGHTON, *New York*
MEREDITH F. CAMPBELL, *New York*
JAMES T. CASE, *Chicago*
ISIDORE COHN, *New Orleans*
FREDERICK A. COLLER, *Ann Arbor*
PAUL C. COLONNA, *Philadelphia*
CHARLES A. ELSBERG, *New York*
GORDON S. FAHRNI, *Winnipeg*
HERBERT C. FETT, *Brooklyn*
EMIL GOETSCH, *Brooklyn*
CHARLES A. GORDON, *Brooklyn*
DONALD GUTHRIE, *Sayre, Pa.*
LOUIS J. HIRSCHMAN, *Detroit*
JAMES M. HITZROT, *New York*
EMILE F. HOLMAN, *San Francisco*
CLAUDE J. HUNT, *Kansas City, Mo.*
WILLIAM L. KELLER, *Washington*
THOMAS J. KIRWIN, *New York*
ARTHUR KRIDA, *New York*
ADRIAN V. S. LAMBERT, *New York*
New York, MAURICE LENZ
New York, JEROME M. LYNCH
New Orleans, URBAN MAES
Newark, HARRISON S. MARTLAND
New Orleans, RUDOLPH MATAS
Detroit, ROY D. MCCLURE
Toronto, D. W. GORDON MURRAY
San Francisco, H. C. NAFFZIGER
Baltimore, EMIL NOVAK
Newark, CLARENCE R. O'CROWLEY
Boston, LOUIS E. PHANEUF
New York, EUGENE H. POOL
Rochester, Minn., JAMES T. PRIESTLEY
New York, DOUGLAS QUICK
Brooklyn, NATHANIEL P. RATHBUN
Raleigh, HUBERT A. ROYSTER
Philadelphia, HENRY S. RUTH
Memphis, ROBERT L. SANDERS
Atherton, Calif., M. G. SEELIG
New York, J. BENTLEY SQUIER
New York, H. J. STANDER
Baltimore, GRANT E. WARD
Woodland, Calif., J. HOMER WOOLSEY

The American Journal of Surgery is published monthly by The Yorke Publishing Co., Inc., 49 West 45th Street, New York 19, N. Y. Yearly Subscription, $10.00 U. S. A.; $12.00 Canada and Pan-American Countries; $15.00 Foreign. Single Numbers $2.00; Special Numbers $4.00. Entered as second class matter August 28, 1926, at the Post Office, New York, N. Y., and on August 28, 1926, at York, Pa., under the act of March 3, 1879. March, 1948—New Series, Volume LXXV, No. 3. *Copyright, 1948, by The Yorke Publishing Co., Inc.*

William Cheselden (1688-1752)

THIS OUTSTANDING ENGLISH SURGEON of the 18th century was noted for his original thought in the development of surgical procedures. His accomplishments included an improved technique in the performance of iridotomies and the perfection of the lateral lithotomy. Performance of this perfected operation more than two hundred times with a remarkably low mortality rate is indicative of the skill and facility which he brought to every surgical problem. Appointed surgeon to Queen Caroline, he later became the first "foreigner" to be elected to the French Royal Academy of Surgery in 1732.

SUTUREGRAM

NUMBER SIX IN A SERIES

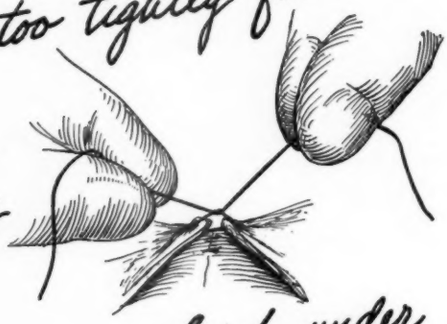
Knots

The set of first knot determines whether the suture will compress the tissues.

First knot set tightly produces small circle. Tissues compressed and anemic. Blood vessels occluded

First knot set properly produces larger circle Tissue not compressed Good blood supply even when edema develops 48 hrs. later

First knot set too tightly for following reasons (1) Attempt made to approximate widely separated tissues



(2) Large suture employed. Fine sutures break under excessive tension (3) In order to prevent slipping of first knot while tying second

SUTUREGRAM

NUMBER SIX (CONTINUED)

Slipping of first knot is prevented by

(a) extra loop in first knot (surgeons knot)

(b) pulling one end quickly toward other (for skin sutures)

(c) Maintenence of slight tension on first knot

Security of second knot maintained by

(1) tying third knot

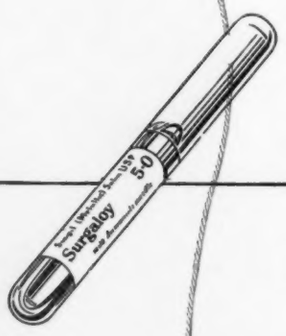
(2) leaving long ends (too much foreign body)

(3) tying all knots flat

no grannys

D&G SURGALOY* *Multistrand* SUTURES

Wire sutures that possess
the basic qualities of Monostrand plus
an ease of handling
approaching that of catgut and silk.
Available sizes now may be obtained
with Atraumatic needles or in 190 inch*
lengths on reels.



DAVIS & GECK, INC.
BROOKLYN 1, NEW YORK
*Registered Trade Mark

doctors

of tomorrow... Of 23,900 enrolled this last year in the nation's medical schools, 13,308 were veterans of World War II.

These young men and women demonstrate that idealism remains an important force in the American way of life; they have chosen to continue to fight—this time against illness and disease.

Here at Bristol Laboratories, we help wage this peacetime battle by providing pharmaceuticals that represent *more* than skill in compounding. They embody an ideal of service, a dedication to quality and purity that is the true measure of the pharmaceutical craftsmen.

Success in pursuit of this ideal is measured in the increasing thousands of physicians who specify Bristol

Painless, 24-hour penicillin therapy

Therapeutically effective penicillin blood levels for more than twenty-four hours *plus* virtual elimination of pain at the site of injection are now possible with 'Duracillin, in Oil' (Procaine Penicillin—G in Oil, Lilly). At the end of a twenty-four-hour period, the average blood level produced by 'Duracillin, in Oil,' is *more than three times that produced by the Romansky formula*. The anesthetic effect of procaine and the absence of beeswax from the formula of 'Duracillin, in Oil,' minimize local discomfort.

Directions for Administration

Shake the vial vigorously to assure uniform suspension; withdraw and administer the dose intramuscularly with a 20-gauge, 1 1/2-inch needle. Although the upper outer quadrant of the buttocks is the preferred site of injection, the deltoid or triceps muscles also may be used.

Dosage

For adults, use the same dosage as that recommended for oil-wax preparations. For infants, 0.2 cc. (60,000 units); children up to ten years, 0.5 cc. (150,000 units); and children over ten years, 1 cc. (300,000 units).

How Supplied

'Duracillin, in Oil,' 300,000 units per cc., is supplied in 10-cc. rubber-stoppered ampoules (No. 465). Refrigeration is not necessary. Available at all retail drug stores.

'Duracillin, in Oil'

Lilly

ELI LILLY AND COMPANY
Indianapolis 6, Indiana, U. S. A.

The American Journal of Surgery

VOL. LXXV — Contents • March, 1948 — NUMBER THREE

Editorial

Present Status of Femoral Neck Fractures . . . . . *Paul C. Colonna* 415

Original Articles

Observations of Burn Scars Sustained by Atomic Bomb Survivors. A Preliminary Study . *Captain Melvin A. Block and Masao Tsuzuki* 417

Tumors of the Carotid Body . . . . *R. A. Donald and George Crile, Jr.* 435

Effect of Intestinal Gases upon Balloons of Intestinal Decompression Tubes . *Meyer O. Cantor, Everett R. Phelps and Robert H. Esling* 441

Survey of Some Aspects of Appendicitis . . . . . *James Y. McCullough* 453

Beaded Wire in Treatment of Slipped Epiphysis of the Head of the Femur . . . . . *Philip T. Schlesinger and Harold T. Hansen* 457

Modified Indirect Inguinal Herniorrhaphy . . . . . *David Weiss* 465

New Test in Diagnosis and Surgical Treatment of Varicose Veins. Two Hundred Vein Ligations Evaluated . . . . *John G. Slevin* 469

Treatment of Varicose Ulcer . . . . . *William M. Cooper* 475

Treatment of Carcinoma of the Breast . . . . . *David W. Robinson* 484

Trauma to the Region of the Bursa Anserina . *Lieut. Colonel Charles J. Sutro* 489

Contents Continued on Page 5

Preoperative CALM

Postoperative COMFORT

PREOPERATIVE apprehension and excitation are readily reduced with Demerol, the potent analgesic, spasmolytic and sedative. In addition to psychic sedation, Demerol facilitates the induction of anesthesia, reduces the amount of anesthetic required, and effectively dries secretions. Compared with morphine, it entails practically no risk or respiratory depression and causes considerably less nausea and vomiting.

POSTOPERATIVE comfort is reliably obtained without interference with the cough reflex or bowel movements and with little danger of urinary retention. Patients in all age groups, regardless of the type of surgery or severity of pain, respond favorably to the drug. Ampuls (2 cc., 100 mg.); vials (30 cc., 50 mg./cc.); tablets (50 mg. and 100 mg.); elixir (50 mg./5 cc.); powder (15 Gm.) for prescription purposes. . . . Council Accepted.

DEMEROL®
HYDROCHLORIDE

Warning: May be habit forming. Narcotic blank required

Write for detailed literature

Winthrop-Stearns INC.
NEW YORK 13, N. Y. WINDSOR, ONT.

DEMEROL, trademark reg. U. S. & Canada
brand of meperidine (isonipecaine).

The businesses formerly conducted by Winthrop Chemical Company, Inc. and Frederick Stearns & Company are now owned by Winthrop-Stearns Inc.

The American Journal of Surgery

Reg. U. S. Pat. Off., Nov. 3, 1936

VOL. LXXV — NUMBER THREE

Contents • March, 1948

Comparative Evaluation of the Effects of Talcum and a New Absorbable Substitute on Surgical Gloves . . . . . *James J. Eberl, William L. George, Louis F. May, Jr. and John Henderson* 493

Surgical Complications of Intestinal Tuberculosis as Seen at Necropsy . . *Stanley A. Kornblum, Charles Zale and William Aronson* 498

Case Reports

Transpyloric Herniation of Redundant Gastric Mucosa . . . . . *K. K. Nygaard and Alexander Lewitan* 502

Repair of Massive Defect of Tibia without Fixation . . . . . *Lieut. Col. Peter-Cyrus Rizzo and Capt. Otto Lehmann* 516

Risk and Well Planned Surgery . . . . . *W. M. Johnston* 519

Chorioncarcinoma . . . . . *Paul Pernworth* 521

Traumatic Rupture of the Thyroid Gland . . . . . *H. Mortimer Bishop and Donald C. Durman* 524

New Instrument

New Type Apparatus for Giving Intravenous Anesthesia . . *Alvin Y. Wells* 526

General Information on Page 6 *Advertising Index on 3rd cover*

General Information

THE AMERICAN JOURNAL OF SURGERY does not hold itself responsible for any statements made or opinions expressed by any contributor in any article published in its columns.

Articles are accepted for publication with the understanding that they are original contributions never previously published. All manuscripts are subject to editorial modification, and upon acceptance become the property of THE AMERICAN JOURNAL OF SURGERY.

A reasonable number of illustrations are supplied free of cost; special arrangements must be made with the editor and publishers for excess illustrations and elaborate tables.

Reprints are furnished on order. Prices are quoted when articles are in page form.

Material published in THE AMERICAN JOURNAL OF SURGERY is copyrighted and may not be reproduced without permission of the publishers.

Change of address must reach us by the 15th of the month preceding month of issue.

PREPARATION OF MANUSCRIPTS

Text. Manuscripts are to be typewritten, on one side of the paper, with double spacing and good margins. The original should be sent to the editor and a carbon copy retained by the author.

Illustrations. Illustrations must be in the form of glossy prints or drawings in black ink (*never* in blue). On the back of each illustration the figure number, author's name and an indication of the top of the picture should be given. Legends for illustrations are to be typewritten in a single list, with numbers corresponding to those on the photographs and drawings. Please do not attach legends to the pictures themselves.

Bibliographies. Bibliographic references should be at the end of the manuscript and not in footnotes. Each reference should include the following information in the order indicated: Name of author with initials; title of article; name of periodical; volume, page and year. The following may be used as a model:

PHANEUF, LOUIS E. Indications and technique. *Am. J. Surg.*, 25: 446, 1937.

The author should always place his full address on his manuscript.

The subscription price of THE AMERICAN JOURNAL OF SURGERY, is $10.00 per year in advance in the United States; $12.00 in Canada and Pan-American countries and $15.00 in foreign countries. Current single numbers $2.00. All Special Numbers $4.00. Prices for such back numbers as are available will be quoted on request.

Address all correspondence to

The American Journal of Surgery

49 WEST 45TH STREET · NEW YORK 19

SOLUTIONS

The complete range of sizes and percentages of dextrose, salt and other special solutions in the Vacoliter meet everyday professional requirements.

BLOOD EQUIPMENT

Baxter Transfuso-Vacs, Centri-Vacs and Plasma-Vacs and accessories reduce contamination risk and make for safer, simpler blood and plasma transfusions.

an integrated parenteral therapy program

ACCESSORIES

Expendable sets for administration of blood, plasma and all Baxter solutions are supplied to the hospital sterile, non-pyrogenic and ready to use.

BAXTER RESEARCH

The modern research department through a progressive development of new solutions, new products and better methods is a significant part of the Baxter program.

Baxter offers hospitals a complete, efficient, integrated service. Uniform containers, standard closures, simple accessories, proven techniques make the Baxter program easy to learn. No other method is used in so many hospitals. Write for descriptive literature.

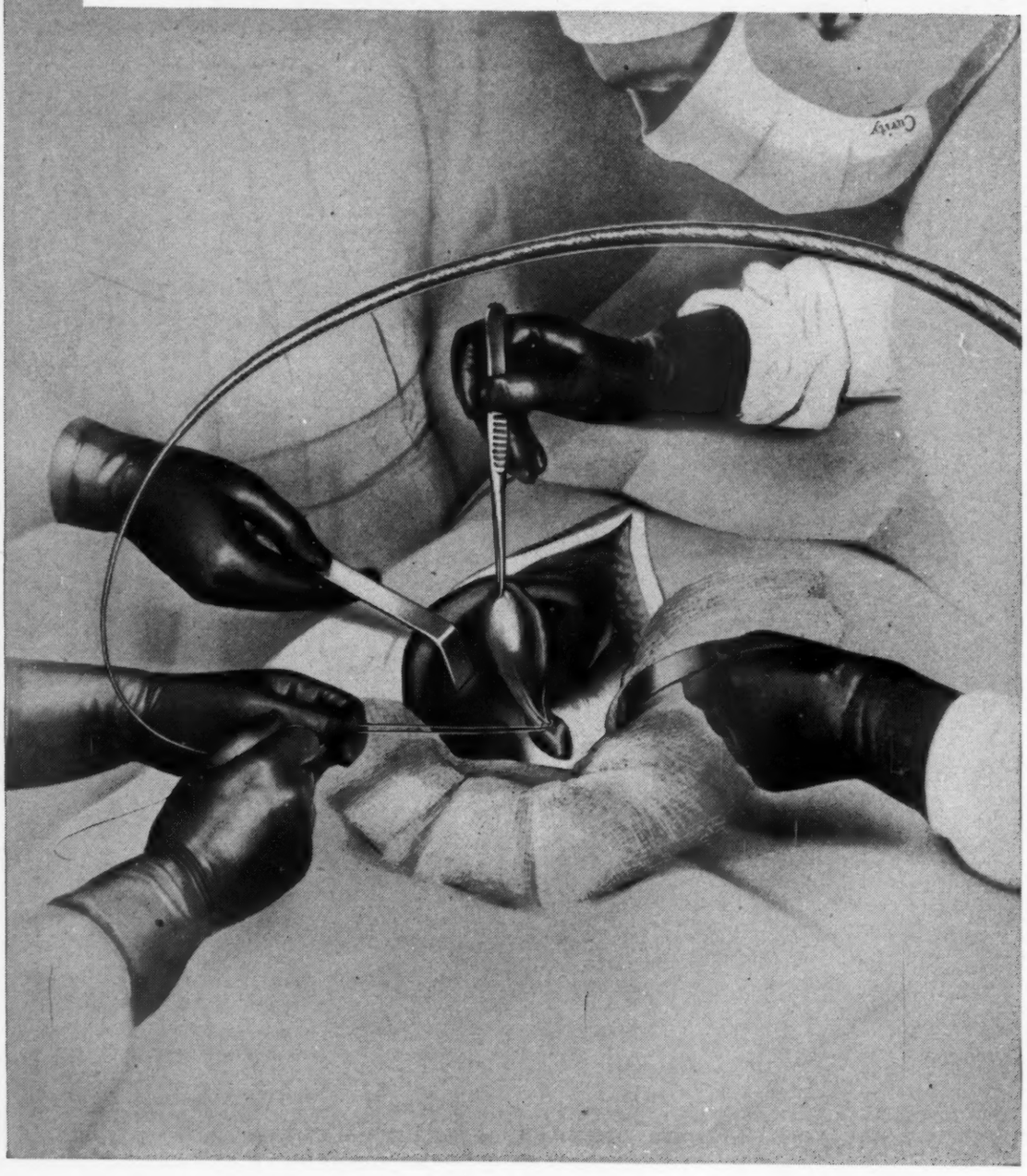
BAXTER *Pioneer Name in Parenteral Therapy*

Manufactured by **BAXTER LABORATORIES**
Morton Grove, Illinois • Acton, Ontario

Produced and distributed in the eleven Western states by DON BAXTER, Inc., Glendale, California

AMERICAN HOSPITAL SUPPLY CORPORATION
Distributors East of the Rockies • GENERAL OFFICES: EVANSTON, ILLINOIS

The invisible quality



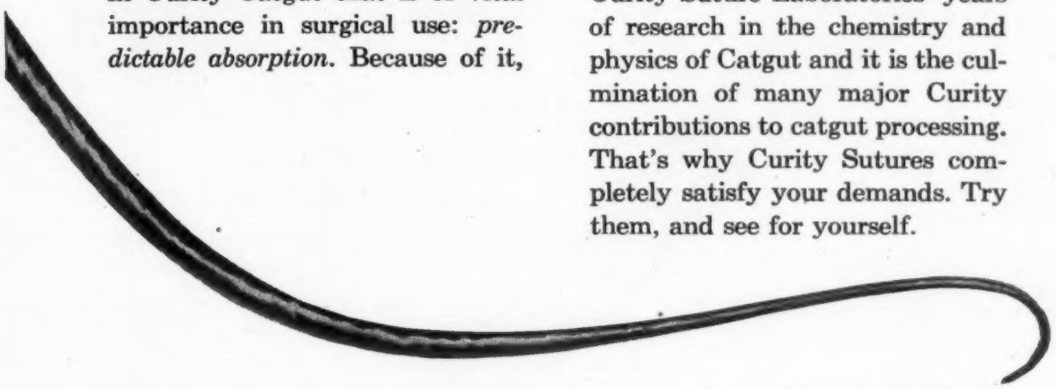
# of vital importance

Surgical use proves predictable absorption of Curity Catgut

Curity Catgut has all of the more obvious advantages of fine sutures — smoothness, pliability, more-than-adequate tensile strength and uniformity. These can be seen or felt.

But there is an *invisible* quality in Curity Catgut that is of vital importance in surgical use: *predictable absorption*. Because of it, you can maintain effective wound closure *within a wide margin of safety*—simply by using a Curity suture of the right size and degree of chromicization.

Predictable absorption is not an overnight achievement. It reflects Curity Suture Laboratories' years of research in the chemistry and physics of Catgut and it is the culmination of many major Curity contributions to catgut processing. That's why Curity Sutures completely satisfy your demands. Try them, and see for yourself.



ORDER THROUGH YOUR DEALER

Curity Suture Laboratories

BAUER & BLACK

Division of The Kendall Company, Chicago 16

Curity REG. U.S. PAT. OFF. SUTURES

SUTURE RESEARCH . . . TO ESTABLISH A FINE BALANCE OF NECESSARY CHARACTERISTICS

TOWNSEND - GILFILLAN

BONE PLATES AND SCREWS

(stainless steel)

for
Immobilization
in FRACTURE
TREATMENT

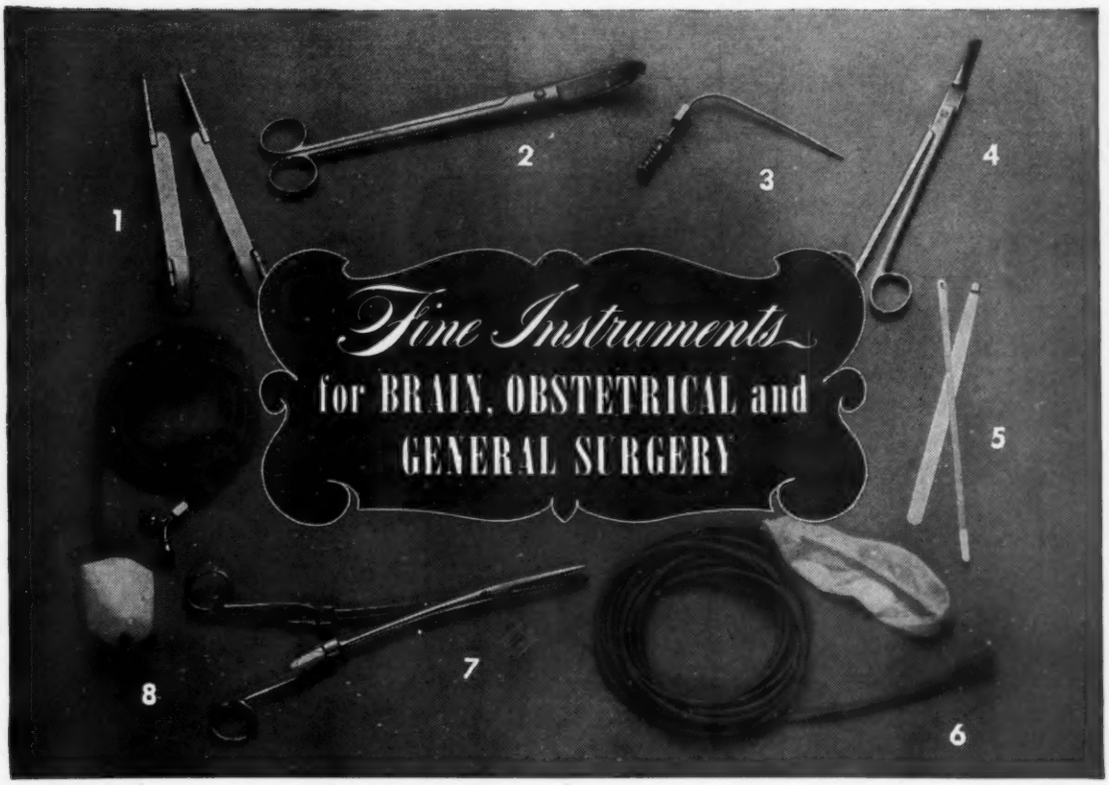
BY ACTUAL TESTS—

T & G Screws Provide
15% GREATER
HOLDING POWER

T & G Plates Provide
MINIMUM METAL
MAXIMUM STRENGTH

Descriptive Literature On Request

WALLACE ORTHOPEDIC SUPPLY CO.
919 Taft Building, Dept. A.
Hollywood 28, California



IN the display cases of leading medical museums, many surgical instruments of earlier days, bearing the PILLING hallmark, testify to the significant contributions to Surgery made by Pilling during the past one hundred and thirty-two years.

The modern Pilling instruments pictured above, designed by acknowledged leaders in brain, obstetrical and general surgery, today embody the traditional qualities of authoritative design and superlative workmanship which have always distinguished instruments made by the house of Pilling since its founding in 1814.

Write today for illustrated literature describing Pilling instruments for Brain, Obstetrical and General Surgery. Address George P. Pilling & Son Company, 3451 Walnut Street, Philadelphia 4, Pa.

(1) P15150-51 Frazier Brain Retractors
(2) P18486 Jones Scissors
(3) P15424 Ferguson Suction Tube
(4) P16992 Sweet Scissors
(5) P15482 Adson Saw Carrier
(6) P9170 Harris Mercury Weighted Tube
(7) P20800 Kennedy Clamps
(8) P9140 Miller-Abbott Tube

INSTRUMENTS BY—
Pilling
INSTRUMENT CRAFTSMEN SINCE 1814

Quality is Imperative . . .

DEMAND SURGICAL INSTRUMENTS BEARING THIS TIME-HONORED TRADEMARK

To the experienced, there can never be a compromise with quality. The skill of the surgeon is predicated to an appreciable extent upon the dependable quality of the instruments at his command. Logically, the superiority of Kny-Scheerer instruments, long traditional among the profession, bears particular emphasis at this time. Quality instruments pay dividends in longer periods of satisfactory service and minimum replacement expense.

•

Available through leading dealers everywhere

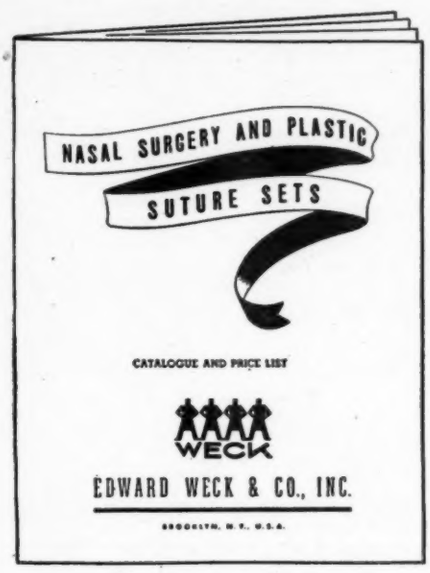
KNY-SCHEERER CORPORATION

483 FIRST AVENUE, AT 28TH STREET • NEW YORK 16, N. Y.

A New BOOK for PLASTIC SURGEONS

Just off the press, yours for the asking, a new 8-page booklet — cover pictured in miniature below — illustrating, describing and pricing recommended sets for nasal plastic and plastic suture surgery.

These instruments are used in the Plastic Surgery Service of the Manhattan, Eye, Ear and Throat Hospital, in the Division of Plastic Surgery, Department of Surgery, of the New York University College of Medicine, Hospital for Special Surgery, St. Luke's Hospital, and Bellevue Hospital all of New York City.

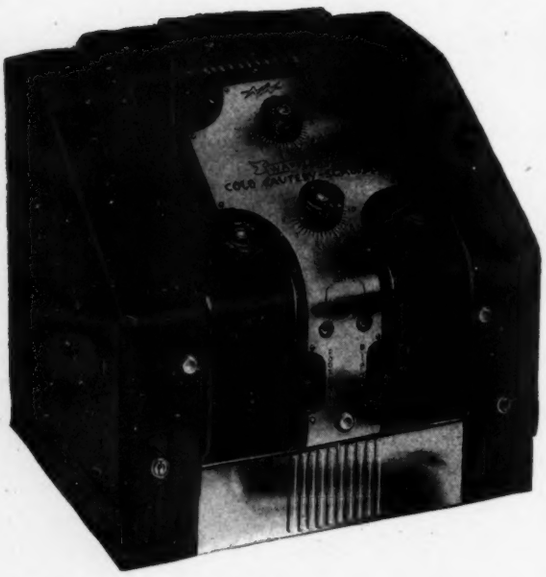


You will see pictured on these pages for the first time many new instruments, including the Converse guarded tip bone ronguer, Converse double-edged scissors, Converse flat angle nasal retractors in three sizes, and many others.

In fact no less than 50 instruments are illustrated, described, and priced in this new book, which, we repeat, is

Yours for the ASKING!

Edward Weck & Co., Inc. Founded 1890
Manufacturers Surgical Instruments
SURGICAL INSTRUMENT REPAIRING • HOSPITAL SUPPLIES
135 Johnson Street Brooklyn, N. Y.



WAPPLER
Cold Cautery
SCALPEL

A Powerful
High Frequency Apparatus
for Electro Surgical Procedures

THE WAPPLER COLD CAUTERY SCALPEL is a miniature high frequency apparatus which provides a high frequency current that can be utilized both for cutting and coagulation. The name "Cold Cautery" was selected to describe the effect of the current when applied to tissue because the electrode itself is cold, while the hot point, or thermal cautery, severs tissue by a searing contact of a heated metal wire electrode. The thermal or hot point cautery has certain limitations for operative work, such as excessive tissue destruction by radiation of heat, which in turn creates severe scar formation.

The Wappler Cold Cautery Scalpel being a high frequency apparatus, provides cutting and coagulating current which may be precisely controlled in intensity.

SPECIFICATIONS

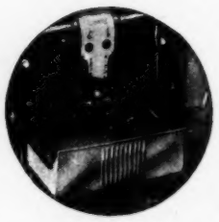
MODEL C-450	MODEL C-450A	MODEL C-450B
is for operation on 110V. A.C. 50-60 cycles.	is for operation on 220V. A.C. 50-60 cycles.	is for operation on 110V. A.C. 25 cycles.

A footswitch and vacuum tubes are furnished with each model.

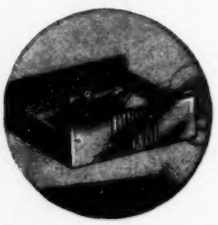
Write for Literature
which completely describes various sets of electrodes and accessory instruments.

Note these Convenience Features

Conducting cords leading to the active and indifferent electrodes are housed within the case. To return the cords to their original position, pressure on the button above them instantly rewinds the cord.



The drawer and contents are automatically ejected from the case upon pressure on a button located directly above the drawer.



The cord connector of the shock-proof footswitch is plugged into the outlet marked "Footswitch." Bipolar electrodes, handle and cord are plugged into the receptacle marked "Bipolar."

Two outlets marked "Light" in center of the panel provide a means of supplying diagnostic light source. Conducting cords may be immersed in sterilizing solution in tray.

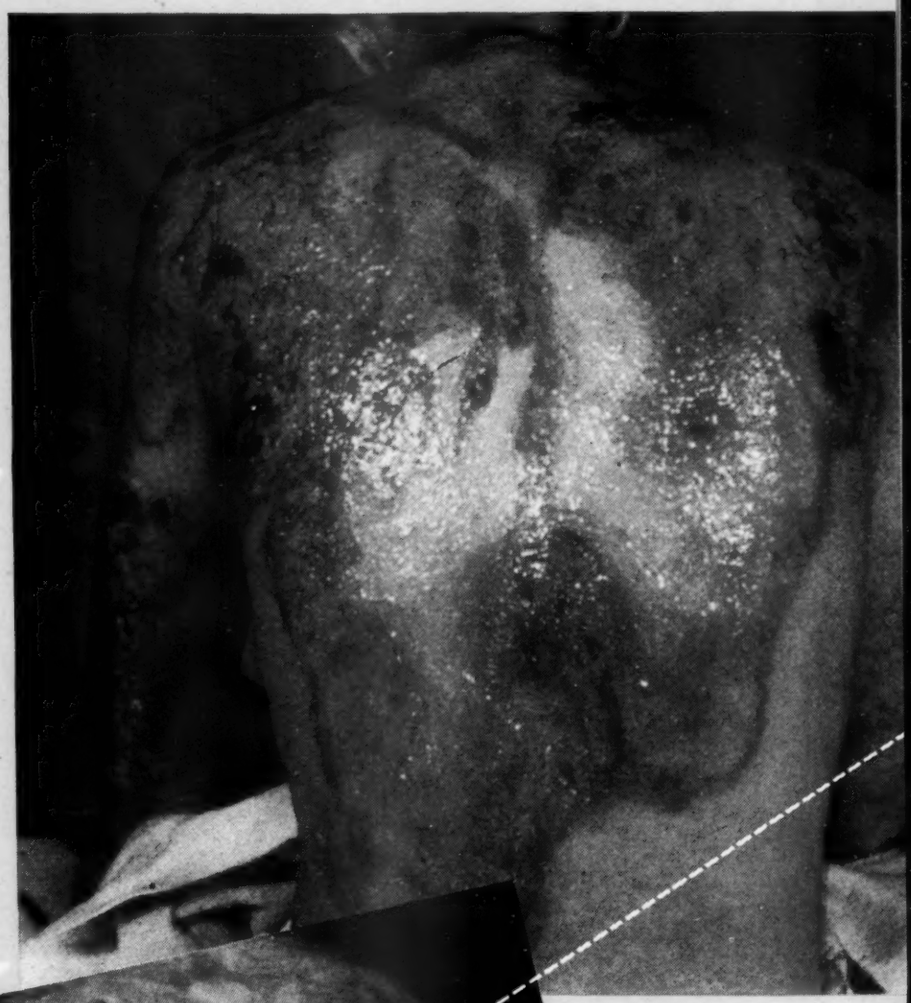
WAPPLER A·C·M·I· TRADE MARK

AMERICAN CYSTOSCOPE MAKERS, INC.
1241 LAFAYETTE AVENUE, NEW YORK 59, N. Y.

Skilled Surgery
Needs Scientific Lighting
Every feature of the Castle No. 12 Light is functionally designed to assist the working surgeon in every stage of any operation.
Mounted on a 7-foot track which rotates around the table, the lamphead can be positioned to provide light at any angle from any point in a 6-foot circle.
Special filters create cool, color-corrected light and multiple light beams from a wide area at many angles make it glareless and shadow-free.
Ask your Castle dealer how and why the Castle No. 12 Light is easier to see with . . . or write us.
Castle
LIGHTS AND STERILIZERS

WILMOT CASTLE COMPANY, 1275 UNIVERSITY AVENUE ROCHESTER 7, NEW YORK

Swift regeneration in

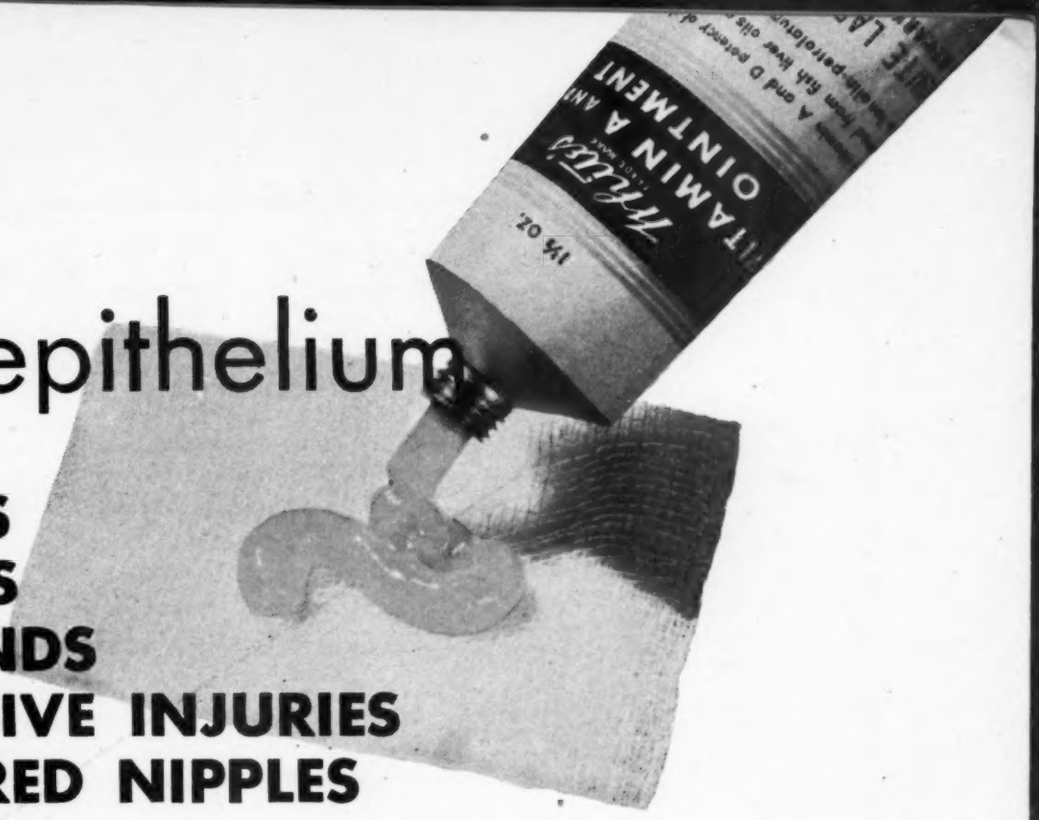


Severe 2nd and 3rd degree burn, treated with pressure gauze dressings and White's Vitamin A and D Ointment. Immediate relief of discomfort.

Same patient 3 months later (treatment was discontinued after one month). Practically complete re-epithelization without resort to skin-grafting.

White's

healing epithelium



in BURNS
ULCERS
WOUNDS
AVULSIVE INJURIES
FISSURED NIPPLES

Advantages of White's Vitamin A and D Ointment:

. . . hastens healthy granulation and epithelization
. . . destroys no epithelial elements
. . . inhibits infection
. . . does not produce contractures

White's Vitamin A and D Ointment provides the natural vitamins A and D, derived from fish liver oils, in the same ratio as found in cod liver oil, in a lanolin-petrolatum base. Pleasantly fragrant; keeps indefinitely at ordinary temperatures; does not stain tissues. In 1.5 oz. tubes; 8 oz. and 16 oz. jars; 5 lb. containers.

Vitamin A & D **Ointment**

WHITE LABORATORIES, INC., Pharmaceutical Manufacturers, Newark 7, N. J.

PAPANICOLAOU

STAIN TECHNIC FOR THE DIAGNOSIS OF EARLY CANCER

IMPORTANT! The taking of smears, scrapings, etc. *in preparation* for staining and diagnosis is a relatively simple matter and can be done by any trained Doctor or Technician—the staining and diagnosis should be done *only by those prepared by intensive training in the technic.*

KIT FOR UTERINE CANCER DIAGNOSIS

Catalog No.			
A–2260	1000 Ayre's "Surface Biopsy"* Scraper. (Packed 500 per box)	per M	$15.00
		per C	2.00
Ref: Selective Cytology Smears for Diagnosis of Cancer, J. E. Ayre, M.D., Amer. Jrl. Ob & Gyn, April 1947			
A–2261	1 Bottle OG 6 and 1 Bottle EA 50 (two bottles)		6.00
A–2262	1 Bottle Harris Hematoxylin	each	1.25
A–2263	12 Vaginal Pipettes	dozen	7.20
A–2264	3 Aspirator bulbs	dozen	7.20
A–1460X	1 gross Rite-on slides, 3 x 1″	gross	2.75
A–1625C	3 dozen two slide mailers with envelopes	dozen	.90
A–2250	Uterine Cancer Diagnostic Outfit, including all of the above items		$36.00
A–2255	Same as above, but without stain (A–2261, A–2262)		28.75
A–2256	Same as A–2255 but with 250 A–2260 Scrapers		18.75

* Pat. Applied for

THE STAIN

THE PAPANICOLAOU STAINS

EA 50 and OG 6 were developed as general stains for vaginal smears. They are particularly well suited for the early detection of uterine neoplasms. These stains have also been employed as useful cytological aids in certain endocrine and sterility studies.

EA 50 and OG 6 have been utilized for the study of exfoliated cells in some body fluids. Atypical cellular structures have been demonstrated in specimens obtained from urinary, parecentetic, thoracentetic, sputum, gastric, and external ulcerated sources.

These stains are to be used in combination with Harris Hematoxylin. This staining procedure results in a sharp nuclear stain, with preservation of nuclear detail and light differential coloring of the cytoplasm which preserves the translucency of the smears.

Harris Hematoxylin (Ortho Modification) was especially designed for use with EA 50 and OG 6. This hematoxylin is an excellent nuclear stain. It is previously acidified, has excellent keeping qualities and is packed ready for use.

"MEDICHROME" SERIES MG3

Trade Mark Regd. U. S. Pat. Off.

VAGINAL and CERVICAL CYTOLOGY SMEARS

Seventy 2 x 2″ (35 mm.) Kodachrome Photomicrographs are now available in a series which will consist of approximately 100 photomicrographs made with the cooperation of DR. J. ERNEST AYRE, Director, Gyne-cytology Laboratory, Royal Victoria Hospital, Montreal, Canada, showing . . .

Normal Cell Patterns in Different Age Groups and
at Different Stages of the Menstrual Cycle, for . . .

A.) Reproductive Period
B.) Post-menopausal Period

Also showing . . .

SELECTIVE CYTOLOGY SCRAPINGS
for
obtaining "Surface Biopsy" for Squamous-Columnar Junction of Cervix.

Write for complete listing

Available!
Kodachrome Sound Film by Dr. J. D. Ayre. Write for details.

WRITE FOR LITERATURE

CLAY-ADAMS CO INC.

44 EAST 23rd STREET, NEW YORK, N. Y.

WRITE FOR LITERATURE

"Pain kills like hemorrhage by exhausting vitality!"

Guillaume Dupuytren

Dupuytren — the great French surgeon — early recognized that pain is not only a symptom, but a pathogenic, destructive factor as well. This is especially true in hemorrhoidal conditions in which there is both pain and hemorrhage, and in which the venous engorgement is aggravated by the inflammatory reaction of the intensely irritated nerve endings.

The rationale of inhibiting hemorrhoidal pain by prolonged local anesthesia, so as to afford the calmed tissues an opportunity to retrogress to normal, is thus obvious. But practical experience is better than theoretical consideration. Since 1930, in many hundred thousand cases

RECTAL MEDICONE

has proved its therapeutic usefulness by . . .

1. Anesthetizing the Hemorrhoids
2. Arresting the Bleeding
3. Promoting Healing

enabling sedentary and industrial workers to maintain their mental and physical efficiency.

Professional Packet Sent On Request

MEDICONE COMPANY
225 Varick Street, New York, N. Y.

RECTAL MEDICONE

Here is why

B-D NEEDLES

are *Professionally Preferred*

All B-D Stainless Steel Needles fit perfectly on B-D glass syringes and lock into the tips of Yale B-D Lok-Syringes.

Designed for easy grip and quick handling. Will not roll. Stamped with name on one side, gauge number on other.

Needle withstands more than twice the reverse bends required by government standards. Juncture of hub and cannula alcohol tested under pressure against leakage.

Hyper-chrome stainless steel cannula, rustless *throughout*. Resists iodine, salts and most acids.

Longer tapered, stronger reinforced Point. Cutting edges shorter and sharper. Result, an extremely keen, smooth point for easy and practically painless penetration.

Yale B-D Lok-Needles are available in both

REGULAR and HUBER POINT

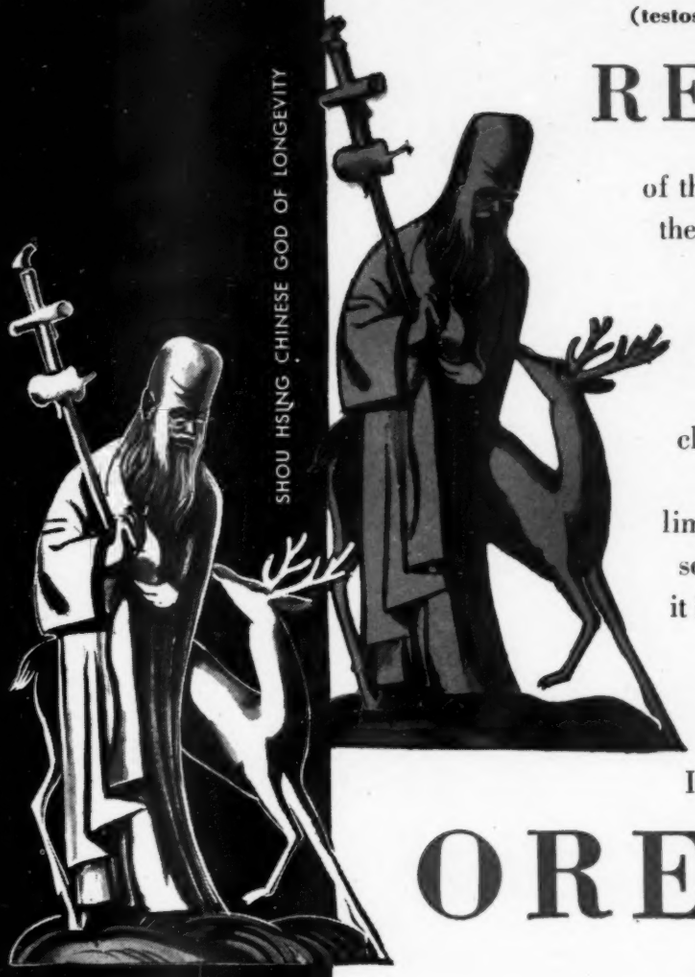
— at the same price

See your **1948 B-D Blotter** for AHA Needle Standardization List

B-D PRODUCTS

Made for the Profession

BECTON, DICKINSON & CO., RUTHERFORD, N. J.



SHOU HSING CHINESE GOD OF LONGEVITY

壽星

ORETON...

(testosterone propionate)

REPLICA

of the natural testicular hormone in the form of the propionic acid ester of the true primary male sex hormone. ORETON* duplicates the activity of the naturally circulating male hormone in clinical effect. Where once it was believed that this action was limited to reproductive organs and secondary sex characteristics, now it is apparent that ORETON has far-reaching metabolic effects, identical with those of testosterone in the male.

In the androgen-deficient patient,

ORETON

has been shown to be capable of

- ***promoting weight-gain***[1]
- ***raising the metabolic rate***[2]
- ***rebuilding muscle substance***[3]
- ***increasing energy and vigor***[3]

Such properties are valuable not only in promoting fullest correction of hypogonadal states but also in checking certain metabolic deteriorations in the aged.

PACKAGING: Ampuls of 1 cc., each cc. containing 5, 10 or 25 mg.; boxes of 3, 6 and 50 ampuls. Also multiple dose vials of 10 cc., each cc. containing 25 or 50 mg.; boxes of 1 vial.

Bibliography: (1) McCullagh, E. P., and McGurl, F. J.: Endocrinology **26**:377, 1940. (2) Thompson, W. O., and Heckel, N. J.: J.A.M.A. **113**:2124, 1939. (3) Goldzieher, M. A.: Geriatrics **1**:226, 1946.

Schering

*®

CORPORATION • BLOOMFIELD, NEW JERSEY

IN CANADA, SCHERING CORPORATION LIMITED, MONTREAL

ORETON

SCHERING

Strength alone is not enough in surgeon's silk . . . uniform strength throughout the entire length of the suture is essential to reduce the possibility of aggravating breaks under strain.

Champion-Paré SERUM-PROOF SILK is a special type braid developed to insure uniformity of strength. It is an easily handled, non-capillary, moisture-proof, non-absorbable suture that is non-irritating to tissues. For 77 years surgeons have looked to GUDEBROD for the best in silk sutures.

specify Champion-Paré

Serum-proof silk sutures

Available through leading surgical supply dealers.

GUDEBROD BROTHERS SILK CO., INC.

225 West 34th Street, New York 1, N. Y.

if the patient needs protein...

DELCOS®

does it!

because Delcos is

palatable
protected
whole protein

Protein therapy is indicated in every branch of medicine. Adequate doses are large doses. But protein hydrolysates and mixtures of amino acids may not be acceptable to the patient, even in small doses, and often cause diarrhea. Whole protein is the logical, clinically proved solution to the problem of protein replacement, and DELCOS Granules are composed of exceptionally palatable, biologically efficient, whole protein.

DELCOS Granules provide casein and lactalbumin, whole proteins of the highest biologic value, protected from wasteful use as energy by carbohydrate, 30%. This unique combination is 20% more effective biologically than beefsteak. And DELCOS Granules are readily accepted by patients, even in large, prolonged dosage. Supplied in 1-lb. and 5-lb. wide-mouthed jars. Write for DELCOS literature and recipe folder. Sharp & Dohme, Phila. 1, Pa.

DELCOS **Protein-Carbohydrate Granules**

SHARP & DOHME

TO ATTAIN

Final Recovery MORE RAPIDLY

The earlier the increased nutrient needs of the postoperative period are satisfied, the sooner will complete recovery be attained. Thus early postsurgical feeding should be instituted whenever feasible.

Tolerated and enjoyed almost as soon as liquids can be taken, the delicious food drink made by mixing Ovaltine with milk serves exceptionally well in postsurgical alimentation. Its low curd tension and easy digestibility make it especially appreciated. This dietary supplement provides the very nutrients needed and in generous amounts as outlined in the table. Furthermore, the delightful taste of a glass of Ovaltine assures its acceptance by all patients who enjoy it both as a mealtime beverage and with between-meal feedings. Served hot or cold, it is equally delicious.

THE WANDER COMPANY, 360 N. MICHIGAN AVE., CHICAGO 1, ILL.

Ovaltine

Three servings daily of Ovaltine, each made of ½ oz. of Ovaltine and 8 oz. of whole milk,* provide:

CALORIES	669	VITAMIN A	3000 I.U.
PROTEIN	32.1 Gm.	VITAMIN B_1	1.16 mg.
FAT	31.5 Gm.	RIBOFLAVIN	2.00 mg.
CARBOHYDRATE	64.8 Gm.	NIACIN	6.8 mg.
CALCIUM	1.12 Gm.	VITAMIN C	30.0 mg.
PHOSPHORUS	0.94 Gm.	VITAMIN D	417 I.U.
IRON	12.0 mg.	COPPER	0.50 mg.

*Based on average reported values for milk.

Chronic osteomyelitis following compound fractures of leg twelve years before. Fourteen surgical procedures had failed to close the cavity. Pain and foul-smelling discharge from sinus caused patient to request amputation. (*Above*) appearance of lesion following saucerization.

Treatment with Chloresium Solution (Plain) daily for first two weeks, then Chloresium Ointment every other day. Cavity showed progressive closure, purulent drainage ceased. Pinch grafts of granulation tissue at base were successful and cavity closed completely. No subsequent breakdown.

CHLOROPHYLL THERAPY—

. . . accelerates healing
. . . stimulates normal cell growth
. . . controls superficial infection
. . . reduces scar formation
. . . is nontoxic—bland and soothing
. . . deodorizes malodorous lesions

Reports from clinicians emphasize the effectiveness of Chlorophyll Therapy as made possible by Chloresium

BOEHME, E. J.	The Treatment of Chronic Leg Ulcers with Special Reference to Ointment Containing Water-Soluble Chlorophyll.	The Lahey Clinic Bulletin, 4: 242 (1946)
BOWERS, WARNER F.	Chlorophyll in Wound Healing and Suppurative Disease.	Amer. J. Surgery, LXXIII: 37 (1947)
GAHAN, E., KLINE, P.R. and FINKLE, T.H.	Chlorophyll in the Treatment of Ulcers.	Arch. Dermat. & Syph. 47: 849 (1943)
HOLMES, G. W. and MUELLER, H. P.	Treatment of Post-Irradiation Erythema with Chlorophyll Ointment.	Am. J. Roentgenol. 50: 210 (1943)
LANGLEY, W. D. and MORGAN, W. S.	Chlorophyll in the Treatment of Dermatoses.	Penn. Med. Journal Vol. 51; No. 1 (1947)
MORGAN, W. S.	Chlorophyll Therapy A Review of 114 cases.	Guthrie Clinic Bulletin, 16: 94 (1947)
SMITH, L. W. and LIVINGSTON, A. E.	Chlorophyll: An Experimental Study of Its Water-Soluble Derivatives in Wound Healing.	Am. J. Surg. New Ser. LXII: 358 (1943)

Chloresium
REG. U.S. PAT. OFF.

Natural, nontoxic therapeutic chlorophyll preparations.
Available at leading drug stores

FREE! Complete literature and clinical samples of Chloresium Solution (Plain), Ointment and Nasal Solution will be sent upon request. Address Dept. AS-3.

RYSTAN COMPANY, Inc.
7 N. MacQuesten Pkwy., Mt. Vernon, N.Y.
SOLE LICENSEE — LAKELAND FOUNDATION

Inject Metrazol intravenously in respiratory and circulatory emergencies, collapse, deep anesthesia, barbiturate poisoning and acute alcoholism.

Metrazol Ampules
1 cc. and 3 cc.
Tablets
Oral Solution
Sterile Solution
Powder

COUNCIL ACCEPTED

Metrazol, T. M. reg. U. S. Pat. Off.

BILHUBER-KNOLL CORP. ORANGE, NEW JERSEY

New Finger Freedom For You in

Pioneer Rollpruf Surgical Gloves

of DuPont Neoprene

You get close to bare-hand freedom, sensitive sheerness and tough durability in Pioneer Rollpruf surgical gloves of DuPont neoprene. Rollpruf flat-banded cuffs, not to be confused with gloves having both roll and band, cling snugly on the sleeve—won't roll down to annoy during surgery. The flat banding reduces tearing, too—gives you more wear for your money. Smooth, comfortable fit—hundreds of hospitals, thousands of doctors and nurses use Rollprufs—like them. Free from allergen sometimes found in natural rubber. Order from your supplier today—or write us. The Pioneer Rubber Company (290) Tiffin Road, Willard, Ohio; Los Angeles, U.S.A.

PIONEER *Surgical Gloves*

The Result of Over 30 Years of Quality Glove Making

OUTSIDE THE IVORY TOWER

We wonder how many physicians know about and read the **Bulletin of the National Society for Medical Research** (published bimonthly at 25 East Washington St., Chicago 2, Ill.). Today we read in our daily newspaper what we take to be an opening gun of another triad on the subject of vivisection. The anti-vivisectionists have donned their war paint and are working to get laws passed that would practically end medical research. A. C. Ivy, in the Jan.-Feb. issue of the Bulletin of the National Society for Medical Research wrote a timely editorial on the subject. In part he said:

"One of the most important facts about antivivisection obstructionism is often neglected in discussions of the subject or is considered only incidentally to the problem.

"It is this—that in effect, antivivisectionists are at war with the community. It is not just a question of medical research versus antivivisectionists. It is also the antivivisectionists against the great body of citizens in the community.

"The recent decision in England of the House of Lords left no doubt how England was henceforth going to consider the antivivisectionists. The Courts have held them to be opposed to the best interests of the community.

"Perhaps some day soon our courts, too, will render such a decision. It is not outside the realm of speculation, and it would certainly be a step in the right direction.

"Even such a decision, however, would be only one blow at the antivivisectionists and would not eradicate them as a present nuisance and a potential danger to the community. Their rejection must ultimately come from the public itself and it will come when the public and its legal representatives realize fully that medical progress and animal experimentation are inseparable."

A million and a half dollars—the largest grant of **Public Health Service funds** ever to be given at one time—was awarded a total of sixty-four colleges, research laboratories and public health institutions throughout the country by the National Advisory Cancer Council of the National Cancer Institute, in Bethesda, Maryland.

The first substantial construction grant ever given by the Council went to the Roscoe B. Jackson Memorial Laboratory in Bar Harbor, Maine, for the rebuilding of the laboratory, destroyed in the disastrous Maine forest fire. This was for $250,000 and was contingent on the securing of further funds from other sources to complete the building, which will cost an estimated $650,000. The first foreign grants ever made by the Council were also made at this session. One went to the Pasteur Institute in Paris, and the other to the Hebrew Institute in Palestine.

The Sixth International Assembly of the International College of Surgeons will be held in Rome, Italy, at the invitation of the Italian Government, during the week of May 16–23, 1948, under the presidency of Professors Raffaele Bastianelli and Raffaele Paolucci of Rome, and Mario Dogliotti of Turin. The Secretary of the Assembly is Prof. Giuseppe Bendandi of Rome. Attendance is not limited to the membership of the College; all surgeons in good standing in their medical organizations are invited.

Detailed information may be obtained from Dr. Max Thorek, General Secretary, 850 Irving Park Road, Chicago 13. For travel information, address the All Nations Travel Bureau, 38 S. Dearborn Street, Chicago, the official travel representatives for this Assembly. Those desiring to present scientific papers address Dr. Karl Meyer, Cook County Hospital, Chicago; Dr. Henry W. Meyerding, Mayo Foundation, Rochester, Minnesota; or Dr. Herbert Acuff, Acuff Clinic, 514 W. Church Street, Knoxville, Tennessee. Those from Canada should direct their inquiries to Dr. Lyon Appleby, 925 W. Georgia Street, Vancouver, B. C.

In response to demand by the profession, **Davis & Geck has commissioned Lejaren A. Hiller,** eminent photographer, to continue his famous pictorial series on "Sutures in Ancient Surgery."

(*continued on page 29*)

DEKNATEL SURGICAL SILK

BRAIDED AND TREATED

"The Original Moisture and Serum-Resistant Silk Suture"

This improved type of surgical silk was introduced by Deknatel.

Because of its extra tensile strength, easy manipulation, non-capillary qualities, and superiority where wet dressings are used, it has become a standard suturing material.

Nurses assigned to hospital operating room duty find that Deknatel Surgical Silk threads easily, is unusually strong and can be resterilized. And when the nurse comes into an O.R.S. position, she learns also that Deknatel fills supply orders *promptly* and *accurately*.

Sold by Surgical—Hospital Supply Houses

DEKNATEL Queens Village 8, (L. I.) New York

THE MASTER HAND

DESERVES A MASTER BLADE

NO careful operator tolerates less than the best in blades! That's why so many insist on Crescent.

They're sharper—with cutting edge ground to a longer, flatter bevel.

They're more rigid—incorporating one-third more of the finest surgical steel.

They're better balanced—with weight evenly distributed (no thinning down from the back).

Performance ***in your own hand*** can alone tell the whole story. If you're not yet using Crescent blades, send for complimentary samples—now! Call your surgical dealer . . . or write to Crescent Surgical Sales Co., Inc., New York.

CRESCENT

CRESCENT SURGICAL SALES CO., INC.
NEW YORK

CRESCENT SURGICAL BLADES

(*continued from page 27*)

The New York Academy of Sciences at its 130th annual meeting, held recently in New York, honored Drs. Erwin Schwenk and Richard Tislow of the Chemical Research Division of Schering Corporation, Bloomfield and Union, New Jersey. The Schering scientists were elected to Fellowship in the Academy, a distinguished honor which is conferred on a limited number of members of the group. Selection is based upon outstanding work done toward the advancement of science.

Although cancer is one of the most curable of all major causes of death if detected early, we must look to research for a more effective method of diagnosis and cure, Dallas Johnson declares in **Facing the Facts about Cancer,** a thirty-two-page Public Affairs Pamphlet issued in cooperation with the American Cancer Society and the National Cancer Institute.

The pamphlet stresses for the average reader the importance of regular examinations and emphasizes the value of cancer detection centers which specialize in the examination of well persons. It also provides him with the latest bulletins from the scientific battlefront.

Cancer represents a more basic research problem than the atomic bomb presented in 1940 when all the fundamental research in that field had already been done.

"Science knows that if an answer to cancer is found, it will be by assembling the findings of many scientists. . . It will take the joint efforts of chemists and physicists, biologists and endocrinologists, pathologists and cytologists—to name just a few involved in the basic research of cancer."

Since 1933, the **Award for Chemical Engineering Achievement** has been presented biennially by McGraw-Hill, publishers of *Chemical Engineering*, to recognize and encourage the co-ordinated group efforts of an entire organization—of its executive, research, engineering, administrative, production, and sales staffs.

Merck & Co., Inc. was chosen for this honor in 1947. The Company is grateful to its employees and to the many others who worked with the Company to make this achievement possible. For the first time, this award has been made to a company primarily concerned with the manufacture of medicinal and nutritional products.

Reading left to right, Charles Wesley Dunn, Dr. Perrin Long, Dr. Edward L. Bortz and Dr. R. L. Sensenich.

The **American Medical Association received** the APMA Scientific Award for Basic Research. At the Scientific Award dinner Dr. Edward L. Bortz, president of the American Medical Association, was presented the illuminated parchment by Dr. Perrin Long, and Dr. R. L. Sensenich, president-elect of the A.M.A. delivered the acceptance address.

"After discussion with representatives of the Hospital Council of Philadelphia concerning recent increases in hospital costs, **the Blue Cross will add 6% to all semi-monthly payments made to member hospitals** throughout 1948.

"To finance this substantial payment, Blue Cross *will not increase subscriber rates,* but is drawing upon its own resources and expressing confidence in its own future. However, Blue Cross operated at a loss of approximately $183,000 for 1947 and will operate very close to even during 1948.

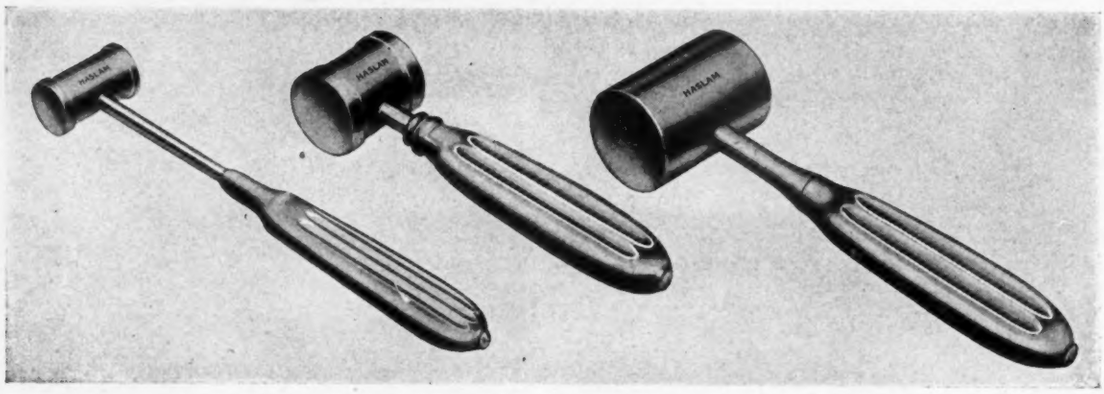
"This action will mean approximately $600,000 in additional income to the hospitals over and above the $10,000,000 budgeted payments contemplated under the present schedule.

"Regular payments are now being made semi-monthly on the basis of an increased schedule put into effect April 1, 1947.

"During its nine and a half years, Blue Cross has paid member hospitals about $30,000,000 for hospital care. It has set aside $3,196,934 or $2.72 per subscriber, as reserves against epidemics and other contingencies.

(*continued on page 37*)

1848 • A Century of Surgical Instrument Craftsmanship • 1948



HASLAM BONE MALLETS

B-1159-5 Bonebrake Orthopedic Mallet, medium and large, brass head and handle, chrome plated.
B-1161 Crane's Orthopedic Mallet, ½ lb. head and 1 lb. head, brass head and handle, chrome plated.
B-1169 U.S. Army Pattern Orthopedic Mallet, 1½ lb. head, brass head and handle, chrome plated.

When ordering specify catalogue number and weight.

Order your **HASLAM** *Instruments through your Surgical Supply Dealer*

EST 1848 Haslam

FRED. HASLAM & Co., INC.
Manufacturers of FINE SURGICAL INSTRUMENTS
83 PULASKI STREET BROOKLYN 6 NEW YORK

Action!

Appearance!

- CORRECT FIT
- MADE BY EXPERTS

Hanger wearers, particularly women, tell us that the natural appearance and the freedom of action afforded are the qualities of Hanger Artificial Limbs that have made them such an important part of their lives. Miss Ferris Jones, a nurse wearing a Hip Control Leg, says: "I am very enthusiastic about my work and study—I never forget that I could not be here—or anywhere that I'd like to be without my leg. I am able to carry on famously—and for me life has regained all its flavor—and my zest for living is just as keen as it used to be. Thank you for making this possible."

HANGER ARTIFICIAL LIMBS

Albany 6, New York
Atlanta 1, Ga.
Baltimore 1, Md.
Boston 16, Mass.
Charleston 2, W. Va.
Charlotte 2, N. C.
Chicago 7, Ill.
Cincinnati 2, Ohio
Columbus 8, Ohio
Indianapolis 2, Ind.
Jacksonville, Fla.
Nashville, Tenn.
New Orleans, La.
New York 11, N. Y.
Oklahoma City 3, Okla.
Philadelphia 7, Pa.
Pittsburgh 30, Pa.
Raleigh, N. C.
Richmond 19, Va.
Roanoke, Va.
San Francisco 2, Calif.
St. Louis 3, Mo.
Washington 13, D. C.
Wilkes Barre, Pa.

all the advantages of iodine

FOR TOPICAL APPLICATION

with no disadvantages

BACTERIOSTATIC

FUNGISTATIC

NON-IRRITATING

WATER MISCIBLE

Samples and brochure sent upon request.

Vodine BRAND

EFFECTIVE CONCENTRATION OF "FREE" IODINE IN SOLUSALVE*

Many years of research and clinical usage has left iodine the uncontested bactericidal agent. Published reports show that "the iodine solution can be diluted over eighty times and still be as bactericidal as the strongest of the other germicides."[1]

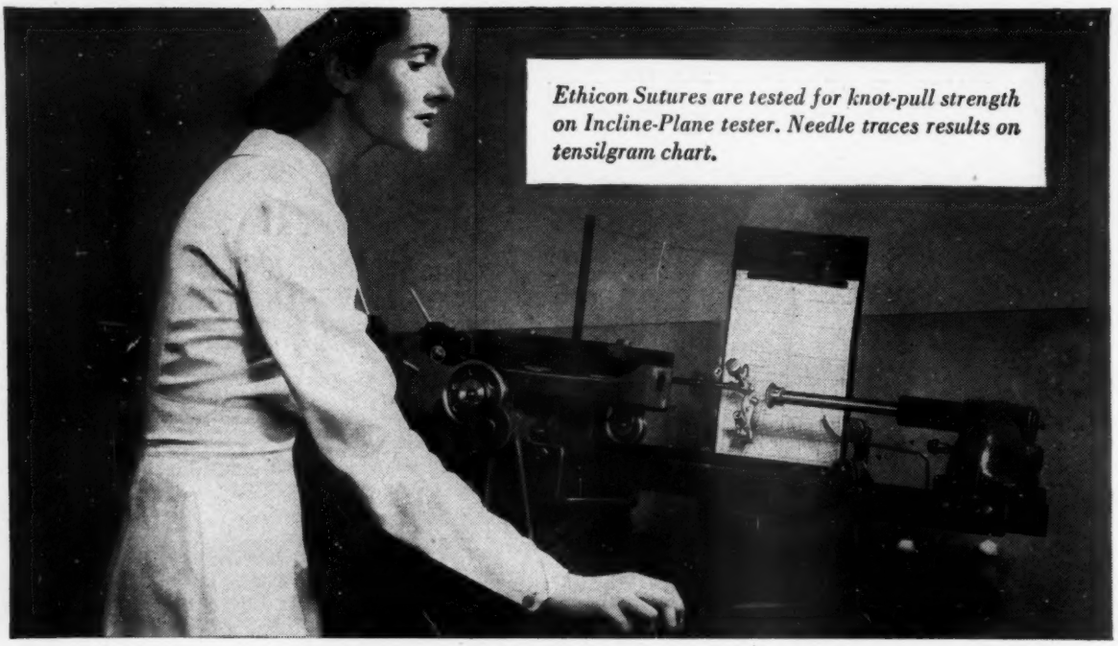
Vodine now makes it possible to utilize the high bactericidal power of iodine against both gram-negative and gram-positive organisms without the old discomfort of "smarting," burning and staining.

Vodine Ointment—"free" iodine in a bland, non-irritating base—is indicated wherever effective topical antisepsis is required: infectious dermatoses, cuts, burns and lacerations. Vodine Ointment has the added advantage of being noninjurious to even delicate skin and may be used safely under bandages or surgical dressings.

*Solubase Brand
1. New England J. Med. 213:279

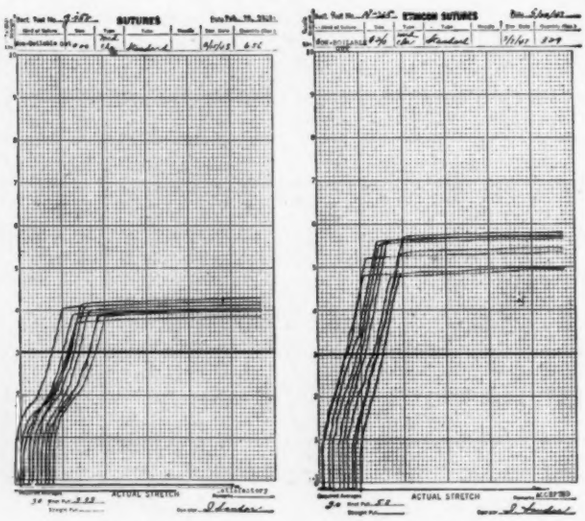
Vodine Company

407 SOUTH DEARBORN STREET • CHICAGO 5, ILLINOIS



Ethicon Sutures are tested for knot-pull strength on Incline-Plane tester. Needle traces results on tensilgram chart.

You get 30% GREATER STRENGTH ...proved by Ethicon's daily tests



TYPICAL 1945 TENSILGRAM TYPICAL 1947 TENSILGRAM

Visual Evidence of Improved Strength in Ethicon's New Bonded Catgut.

Horizontal heavy lines at numeral 3 mark U.S.P. requirements for Knot-Pull strength on Size 00, Non-Boilable Catgut.

Curves show breaking points. Current production of all sizes is up to 30% stronger.

The crucial test of suture strength — just as you tie the knot! Then strain is greatest.

At this stage, efficiency of action is especially important to the smooth performance of the operating team.

A greater margin of safety than ever awaits you in Ethicon's New Bonded Sutures. They are up to 30% stronger than sutures previously produced.

Ethicon's new bonding processes are a significant factor in achieving this increased strength.

ETHICON SUTURE LABORATORIES
Division of Johnson & Johnson
NEW BRUNSWICK, N. J.

ETHICON *Sutures*

SUPERIOR IN THOSE QUALITIES IMPORTANT TO THE SURGEON

The American Journal of Surgery

Copyright, 1948 by The Yorke Publishing Co., Inc.

A PRACTICAL JOURNAL BUILT ON MERIT

Fifty-seventh Year of Publication

VOL. LXXV MARCH, 1948 NUMBER THREE

Editorial

PRESENT STATUS OF FEMORAL NECK FRACTURES

THIS fracture still continues to be the "bête noire" of all who treat fractures. The old age group in which the majority of these fractures occur and the mechanical and circulatory complexities of the head and neck of the femur present practical difficulties. In addition, the late complications of aseptic necrosis of the head or hypertrophic arthritis of the hip joint occurring both with and without bony union are becoming more widely appreciated.

The weight of the body at the hip is not borne by direct weight thrust through the long axis of the bone but obliquely through the head, neck and the shaft. This means that longitudinal or lateral traction can not be effectively utilized and, therefore, external or internal splinting must be employed. A long period without weight-bearing is always necessary while this fracture is healing if one is to avoid introducing the added factor of shearing stress and strain.

It has now been about sixty years since Whitman, in 1890, after careful anatomic study of the mechanics of the hip joint announced his abduction method of reduction with external splinting, using plaster of Paris. His method consisted of manual traction, internal rotation and abduction, all done with meticulous attention to details. Whitman frequently quoted Sir Astley Cooper as representative of the opinion of his day toward this fracture. In 1823 Cooper had stated that the failure of union in this fracture was inevitable because it was impossible to fix the fragments in apposition and he believed that this fact should be officially recognized. He stated that, "Otherwise dissatisfied patients might seek legal redress for a disability for which the surgeon was not responsible." Such a dominant personality as Whitman aroused bitter personal antagonism in his fight against the widespread lethargy in this type of thinking. It must be acknowledged, however, that he certainly succeeded in awakening the profession to a new concept regarding the fundamental principles that were employed in reducing a fracture of the neck of the femur. Today he can truly be considered as "an exponent of a radical reform in this type of fracture."

For many years there have been sporadic efforts to immobilize these fractures by some form of internal fixation and in Moorehead's book, Lambotte refers to Berenger-Feraud who used metal fixation in 1870. John B. Murphy many years ago recommended internal fixation with nails,

and in 1915 Albee described the bone graft peg for this type of fracture. In 1931 Smith-Petersen introduced his three flanged nail, and in 1932 Johansen described the cannulated flanged nail. Both Smith-Petersen and Johansen have introduced an effective method of internal splinting and have stressed the principles of accurate reduction and adequate immobilization. They have, in addition, introduced the factor of early movement of the hip by a method impossible with the Whitman abduction plaster. Other internal fixation methods have been introduced in succeeding years and various types of screws, bone grafts and pins have been employed, the most recent being the spring type of screw fixation which aims at constantly coapting the fractured surfaces. Today an adequate reduction, checked by anteroposterior and lateral views of the hip must be obtained if the patient is to be given the best opportunity for bony union.

Certain important facts regarding the circulation of the femoral head and neck have been worked out by Wolcott, Kolodny, Phemister and others. Wolcott has proven that the ligamentum teres fails to supply the head of the femur in about 20 per cent of adults and that the bone is nourished mainly through the superior and inferior capsular arteries and small branches from the nutrient artery of the femur. Vascularity diminishes as we approach the femoral head and in many hip fractures these blood vessels are severely damaged, making it likely that a certain percentage of cases, irrespective of the methods of fixation employed, will probably go on to non-union. Unfortunately, as yet we have no accurate method to determine the type of intracapsular fracture that one may feel certain will go to non-union. If this could be determined, much time and sometimes life could be saved by immediately resorting to an osteotomy or reconstruction operation, procedures that are today largely reserved for cases with frank non-union.

There are certain mechanical factors that influence healing, one being the valgus position. This position of the head fragment, as well as placing the pin very obliquely so that one flange of the nail engages the heavy cortical bone on the inferior surface of the neck and assures more secure fixation, offers a better opportunity for bony union.

With increasing knowledge regarding geriatrics, a decrease in the mortality rate of the elderly patients has resulted. A committee from the American Academy of Orthopedic Surgeons in 1941 reviewed 923 cases of central fractures, finding a mortality of 11.6 per cent and Boyd has recently reported on 300 patients with this type of fracture and a mortality rate of 9.3 per cent.

In addition, there are local complications which are very serious and which remain largely unsolved. Patients with fractures which unite or remain ununited may develop an aseptic necrosis of the head of the femur or an unusual degree of hypertrophic arthritis. These two complications produce serious results and one finds it difficult to explain how they develop two, three or more years after evidence of solid bony union at the site of the neck fracture. From the best statistics available today one may anticipate the development of late aseptic necrosis in approximately one-third of the cases united by solid bony union! Until these two serious complications have been solved the fracture will still remain what Kellogg Speed has called it, "The Unsolved Fracture."

Paul C. Colonna, M.D.

Original Articles

OBSERVATIONS OF BURN SCARS SUSTAINED BY ATOMIC BOMB SURVIVORS

A PRELIMINARY STUDY

CAPTAIN MELVIN A. BLOCK AND MASAO TSUZUKI, M.D.*

Medical Corps, Army of the United States *Tokyo, Japan*

MANY of the burns sustained by atomic bomb survivors have healed with accumulations of excessive amounts of elevated scar tissue, many having the gross appearance of severe scar keloids. An effort has been made, therefore, to collect data and information which might help explain why this occurred. An observational study was made on survivors at Hiroshima and Nagasaki as well as on patients in Tokyo hospitals who had been burned from other causes than the atomic bomb explosion. The work was done jointly with Japanese investigators including physicians in the Japanese Red Cross and Post Office Hospitals in Hiroshima, the Nagasaki Medical College, and the Tokyo Imperial University School of Medicine, the First and Second National Hospitals in Tokyo. This is not intended to be an exhaustive study of the problem.

The burns as seen in 1945 after the atomic bomb explosions were largely flash burns, the result of radiant heat emitted at the time of the explosions and were thus limited to exposed areas of the skin ("profile burns") or to places where overlying clothing was in intimate contact with the skin (especially clothing of dark color).[1] All degrees of severity of burns were seen. In survivors a majority of burns were first or second degree severity, these usually healing rapidly and within four weeks. However, nearly all burns of second degree or worse became infected, this often increasing the severity of the lesions. This was especially true in those individuals suffering from the effects of ionizing radiation, healing usually being delayed in such cases. Thus, many cases of the more severe burns did not heal until October and November, 1945, or later. It was then in these months, after or concomitant with surface healing of these burns, that keloid and hypertrophic scar formation began to be noticed. Treatment of the burns was limited largely to local applications and dressings; relatively few received transfusions of small amounts of blood. Early skin grafting was not done.

The elevations of scar keloids and hypertrophic scars continued, in general, to increase for a few months after their presence was first noticed; a very few were said to be enlarging when seen over one year after the injury. At first, they were red in color, the color gradually fading and after ten to twelve months becoming more brown in color, especially in lesions on the hands. Their surfaces were smooth and shiny, but wrinkling of the surfaces appeared after about a year, indicating contraction. Some have decreased slightly in elevation since the spring of 1946. Many of the individuals with scar keloids complained of hyperesthesias and parenthesias

* Chairman, Medical Section, Special Committee for the Investigation of the Effects of the Atomic Bomb, the National Research Council of Japan.

FIG. 1. Relatively severe scar keloid formation, as seen February, 1947. The patient, age fifteen, was 1.7 kilometer from the ground center at Hiroshima, standing in line with other schoolboys along a street. He wore a khaki blouse which protected him up to his neck. No symptoms or signs of radiation illness were elicited by his history. The keloid had continued slowly to enlarge in elevation. It was brown-red in color and nearly 1 cm. in elevation. The remainder of the left side of his face and neck was hyperpigmented. (Photo by U. S. Army Signal Corps.)

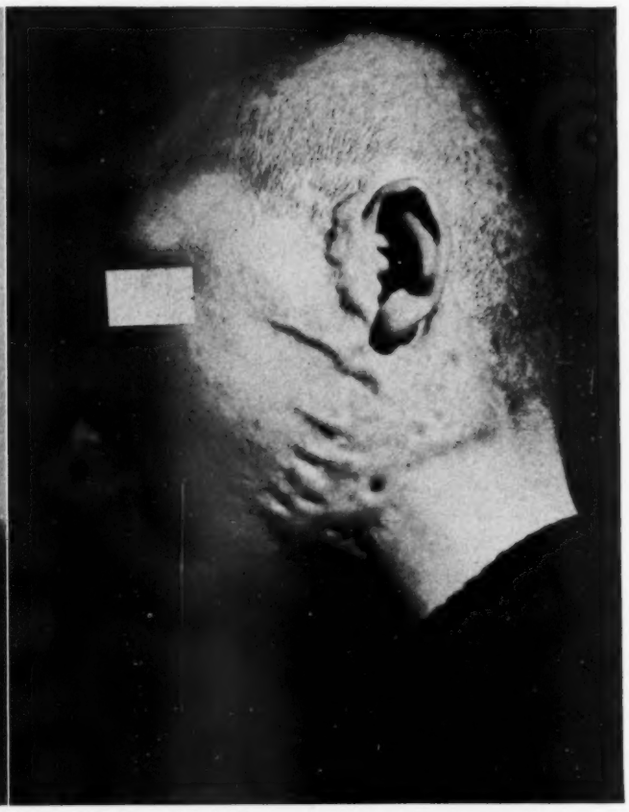


FIG. 2. Scar keloid formation of moderate severity, as seen January, 1947. The patient, age seventeen, was 1.6 kilometer from the ground center at Hiroshima, standing outdoors. No signs or symptoms of radiation injury were noted. The scar was pink in color and was relatively pliable. Most of the surrounding skin of the left cheek was hyperpigmented. This case is typical of the majority of those seen. (Photo by U. S. Army Signal Corps.)

in the lesions, but these symptoms have decreased in intensity with the elapse of time.

The gross appearance of the scarred areas as seen now in large numbers of survivors varies greatly. Some are composed of rather thin atrophic scar tissue while in many other cases the scar tissue is extremely thick and elevated above the surface of the surrounding skin. Vascularity as inferred from the gross appearance also varies a great deal. Judging from gross examination, nearly all burned areas are now completely healed. At the time of this study (December, 1946, to April, 1947) ulcerated areas were still seen in some burn scars and scar keloids, ulceration usually being located at points of stress as in contractures. Large numbers of contractures have occurred at locations where these usually develop. Pigmentary changes are still evident, but the intensity of hyperpigmentation present in many of the exposed skin surfaces has decreased greatly. Hyperpigmentation and depigmentation now serve to outline the original area of burn in many cases. In the central part of some scars, especially those located on the hands and feet, are completely depigmented areas.

The difficulties involved in arriving at a working definition of a scar keloid and the empirical criteria used in this study are

FIG. 3. Relatively severe scar keloid formation, as seen April, 1947. The patient, age twenty, was 1,330 meters from the ground center at Hiroshima, walking along a street in the open. He was wearing a white shirt with sleeves down to his elbows. A partial diffuse epilation of his scalp hair occurred, and diarrhea and gingival bleeding were noted after the bombing. The lower 3 to 4 inches of the keloid on the right forearm were excised July 12, 1946, and the wound then closed. Keloid formation appeared in the line of closure in September, 1946, and by November, 1946, had reached the same elevation that it had been prior to excision. The keloids on the forearms were elevated 1 cm. or more, were firm and their edges were sharply demarcated; at some places they tended to overhang onto the surrounding skin. Each keloid was surrounded by a depigmented area and this then was surrounded by a thin hyperpigmented border. (Photo by U. S. Army Signal Corps.)

FIG. 4. Severe scar keloid formation, as seen February, 1947. The patient, age thirty-six, was 1.5 kilometer from the ground center at Hiroshima, standing with his back facing the center. He sustained flash burns under the half-sleeved white shirt that he was wearing. Epilation of about half of his scalp hair occurred, his hair all returning in October, 1945. Dilated blood vessels were seen on the surfaces of the keloids, especially at their margins. Keloids were elevated about 1 cm. above the surrounding skin surfaces. He complained of pruritus in the keloids, especially in cold weather. The keloids were surrounded by depigmented areas which were then surrounded by a thin hyperpigmented margin peripherally. (Photo by U. S. Army Signal Corps.)

discussed herein. The areas of scar keloid formation as seen now typically occupy the central part of the burned area (where the burn was most severe, probably third degree, and where it healed last) and are surrounded by a depigmented corrugated non-elevated area (this probably having been a second degree injury), this in turn being surrounded at its periphery by a thin hyperpigmented margin. Elevation of keloidal areas varies from a few millimeters to about 1½ cm. above the surrounding skin. Most of the lesions have well demarcated edges. A number of the lesions had claw-like extensions, this feature usually seen along the neck or side of the face.

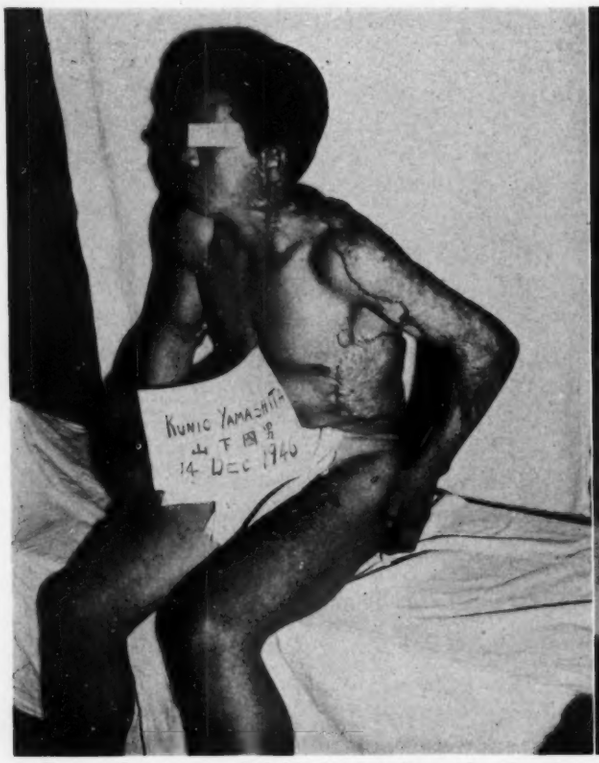


FIG. 5. Severe scar keloids in a patient who also developed scar keloids in a donor site for a skin graft, as seen December, 1946. The patient, age seventeen, stated that he was located 2.5 kilometers from the ground center at Nagasaki. He was standing in the open, leaning on a shovel with his arms behind him, his back facing the center of the explosion. He wore only short black wool pants and no shirt. Keloids on his arms and back were elevated about 1 cm., were pink in color and were surrounded by a depigmented zone. It was said that a Thiersch graft was removed from his left thigh and applied to his left foot after excision of a scar keloid. Scar keloid formation has developed at this donor site on his left thigh. (Photo by U. S. Army Signal Corps.)

FIG. 6. Marked scar keloid formation at sites of lacerations from shattering glass, as seen April, 1947. The patient, age thirty-eight, was 1.2 kilometer from the ground center at Hiroshima, sleeping in a prone position in the center of a room on the second floor of her home (wood construction). Glass struck her from all directions piercing her clothing and causing lacerations of her back, neck, shoulders and arms. Slight epilation of the frontal part of her scalp occurred in November, 1945, all hair later returning by February, 1946. No burns were sustained. She has had no previous comparable skin lesions. No one else in her family was known to have developed keloids. (Photo by U. S. Army Signal Corps.)

Areas involved vary from a few centimeters diameter to almost complete coverage of the back or forearm. Dilated blood vessels are visible on the surfaces of some scar keloids.

ANALYSIS OF CLINICAL DATA

A major problem in this study consisted of attempting to determine what a scar keloid actually is. It has been found impossible from clinical observations and histologic studies of excised scar tissue to arrive at a working definition that will differentiate scar keloids and hypertrophic scars. If one desires to use both of these terms, the differentiation must be on an arbitrary and empirical basis. It seems regrettable that the word keloid, at least as it has been used up to now, tends to give one the impression that it names a well defined lesion. It would seem that scar keloids and hypertrophic scars differ only in the degree of accumulation of scar tissue after healing of the surface of the lesion. Statistical data on this subject are highly colored by what each investigator's own impression was concerning the clinical appearance of a scar keloid. In general, most investigators tended to consider any elevated scar as a scar keloid.

This study is based on data collected from December, 1946, to April, 1947, on ninety atomic bomb survivors in Hiroshima and Nagasaki. Eighty-seven had been burned while three had sustained lacerations only at the time of the explosions. In addition, twenty-five Japanese patients who were burned by other causes than the atomic bomb explosion were studied in Tokyo hospitals.

Of the total of ninety cases of atomic bomb survivors, forty-nine (54.4 per cent) were considered to have burn scar keloids. The criteria for this clinical classification were purely empirical, a scar keloid being considered as a definitely elevated (3*mm. or more) scar with sharply demarcated borders, the scar usually appearing as a single, rather uniformly elevated mass. This group of forty-nine cases then could be further broken down depending upon the mass and elevation of the scar tissue into severe cases, eight (8.9 per cent); moderately severe cases, twenty-one (23.3 per cent); and mild cases, twenty (22.2 per cent). This use of the term, scar keloid, and this classification serve only to give one an idea of the distribution of the cases as to severity of the lesions. (Figs. 1 to 4.)

Over half of the patients seen were hospitalized for plastic surgery or were outpatients of hospitals and, therefore, included the more severely injured. To obtain a better cross-section view of healed burns of all severity, forty-one of the ninety cases were studied by random selection, i.e., were from groups of school children and post office employees in which every burned person was studied. Of these forty-one, nineteen (46.5 per cent) were considered as showing scar keloids.

In the Tokyo hospitals twenty-five patients being treated for scars which resulted from burns of other causes were seen. Nearly all cases had been burned over one year before, eighteen out of the twenty-five having received their injury between eighteen and twenty-four months previously. This was a relatively select group in that they included the more severely burned cases, namely, those requiring hospitalization for treatment of extensive scars. Twenty were considered to have sustained flash burns from incendiary bomb or gasoline explosions, four were burned by flames or after their clothing ignited, one by a gunpowder explosion and one by nitric acid. Of the twenty-five patients, there were ten (40 per cent) considered to have developed scar keloids. (Fig. 7.)

FIG. 7. Severe scar keloids following healing of flash burns due to a gasoline explosion, as seen February, 1947. This boy, age nineteen, sustained burns April 13, 1945, in Tokyo, when gasoline exploded nearby, secondary to the explosion of an incendiary bomb. These lesions are entirely comparable to those seen in atomic bomb survivors. The burns of this patient occurred only on exposed skin areas, as shown by the sharp lower edge of the keloid on his neck, below which a collar protected the skin. The scar keloid was pink in color. (Photo by U. S. Army Signal Corps.)

The patients in the Tokyo hospitals had apparently received more care than atomic bomb survivors during the period just after the occurrence of their burns; but the type of treatment was much the same as that given to the atomic bomb survivors, consisting largely of local application of oint-

ments with dressings. Six had been grafted but none was grafted within four months after his initial injury and in most cases grafts were applied after six months. The skin grafting was done when the burns were completely healed or nearly healed with scar tissue.

It was impossible to judge at the time of this investigation what the severity of the burns from any of the groups had been initially, especially in view of the fact that infection, as was universally present in burns of atomic bomb survivors, could have increased their severity as to depth and area involved. Surfaces of all of the scar keloid areas were thought to present the appearance of scars following the healing of third degree burns. Thirteen of the atomic bomb survivors who were classified as not possessing scar keloids did have scars thought to present the appearance of scars following healing of third degree burns.

There were four cases of scar keloid formation at the sites of lacerations which resulted from shattering glass at the time of the explosion. (Fig. 6.) Keloid formation in such lesions actually seemed to occur only infrequently. In a random selection of twenty-six other individuals (nurses and post office employees) who had scars of lacerations, none had developed scar keloids.

Most of the cases of scar keloids (64 per cent) and also patients considered to have only hypertrophic or usual scars (75 per cent) were between the ages of eleven and twenty. Literature on the subject indicates that keloids do occur most frequently in this age group, but the data accumulated in this study are from selected groups and are insufficient to permit a definite conclusion.[2,3] Of the ten cases of scar keloids in the control series, one was in the one- to ten-year age group, two were between eleven and twenty, three were between twenty-one and thirty and three were between thirty-one and forty. Eleven of the fifteen remaining patients with ordinary type scars were between twenty-one and thirty years of age.

Most of the survivors studied were located between 1,500 and 2,000 meters from the ground center at the time of the atomic bomb explosions. This is understandable since, in survivors, the "burns were greatest not only in incidence but also in severity at about 1,500 to 2,000 meters."[1] The majority of those who had been closer to the center and so located as to sustain a severe burn did not survive. Approximately one-third of both the group of scar keloid patients and the group with ordinary type scars were within 1,500 meters of the ground center. In the series of scar keloid cases, only one had been beyond 2,500 meters of the ground center, this case having been located at 2,900 meters. There was no consistent relationship between distance from ground center of the explosion and the incidence of scar keloid formation except that which seemed well correlated with the variation of severity of the lesions with distance.

It was believed that plastic surgery had been done on too few of the patients to warrant conclusions regarding the frequency of recurrence of keloids and occurrence of keloids in donor sites for skin grafts. A number of patients had recently undergone surgery, but the final outcome is yet unknown. Three of ten patients who had been grafted following removal of scar keloids showed recurrence of keloids, and two others developed hypertrophic scars in grafted areas. These recurrences were especially located where grafts had apparently not taken well. Four of eight patients developed keloids again along lines of closure following excision of keloids with primary closure. Three of eight patients showed development of keloids in donor sites, two said to have been Thiersch grafts (although the type of scar now present after keloid formation would indicate that they might have been deeper) and one at the site of "pinch" grafts. (Fig. 5.)

In the group of patients in Tokyo hospitals, one of six cases showed recurrence of

keloids in grafted areas. Scar keloid excision with primary closure was done in one patient without recurrence of the keloid. Two of four cases were thought to have developed very mild scar keloids in donor sites for full-thickness grafts.

burns sustained from the atomic bomb explosion, but only three other persons stated that other surviving members of their family had been burned. Two of the patients showing scar keloid formation at the sites of lacerations are mother and

TABLE 1
INCIDENCE OF SCAR KELOIDS IN SCHOOL CHILDREN

Group	Distance from Ground Center	Total No. Seen	No. Burned	Patients with Keloids		No. Having Radiation Illness
				No.	Per Cent	
First High School, Hiroshima Prefecture.....	1.6 km.	75	46	41	(89.1)	9
Second High School, Hiroshima Prefecture.....	2.1 km.	71	55	52	(94.5)	5
Commercial School, Hiroshima Prefecture.....	2.1 km.	130	114	95	(83.3)	4
Second High School, Hiroshima Prefecture.....	2.3 km.	159	156	51	(32.6)	3
First High School, Hiroshima Prefecture*.....	1.2 km.	16	1	1		16
Third Primary School, Hiroshima Prefecture...	1.3 km.	24	19	7	(36.8)	24

* A total of 150 persons were in this group; about one-half died as a result of mechanical injuries and radiation injury. This group was indoors; only one person sustained burns.

The anatomic distribution of scar keloids depended, of course, upon the distribution of the burns and, therefore, were seen largely on exposed skin surfaces. The head and face were involved in 21 per cent of cases, neck in 24 per cent, arms in 12 per-cent, back in 10 per cent, forearms in 9 per cent, anterior chest in 6 per cent, legs in 6 per cent, shoulders in 5 per cent, dorsum of hands in 5 per cent and feet in 2 per cent. In the Tokyo group of control patients the head and face were involved in 26 per cent, dorsum of hands in 20 per cent, neck in 16 per cent, forearms in 16 per cent, legs in 11 per cent and feet in 11 per cent. Eight of twenty-five atomic bomb survivors who were burned beneath clothing developed scar keloids at the sites of these burns. Of the Tokyo patients, three sustained burns beneath clothing but none developed scar keloids in such burns.

Six of the atomic bomb survivors stated that their keloids were still increasing in elevation. Five still complained of chronic ulcers at sites of scar keloids. Many had developed contractures. Five patients gave a history of another member of their family having developed scar keloids in

daughter; they were together at the time of the explosion. No case studied had ever developed scar keloids at the site of any skin lesion prior to the atomic bomb injury.

There were thirty-one patients giving a history of signs or symptoms of radiation illness (epilation, diarrhea, hemorrhagic tendency) after the bombing. There were four cases with a questionable history. All of these individuals were within 1,800 meters of the ground center at the time of the explosion. Twenty-two of these thirty-five patients were considered to have developed scar keloids; twelve did not.

Reports by other investigators all give what appear to be relatively high figures for the incidence of keloids in burn scars in atomic bomb survivors. The figure will vary with the investigator, his concept of the clinical appearance of a scar keloid and the group of survivors studied. Hatano, Uchida and Watanuki from the Tokyo Imperial University School of Medicine surveyed groups of school children at Hiroshima in December, 1946.[4] Persons in each group were at approximately the same location at the time of the explosion. All patients who sustained burns were out-

side in the open. The results of their study are shown in Table 1.

Dr. Yoshio Ito, dermatologist at the Hiroshima Japanese Red Cross Hospital, in a study of 606 burn cases between September, 1945, and February, 1946, found 210 (34.7 per cent) that he considered to have developed scar keloids.[5] He emphasizes that this incidence is that only of scar keloid formation, those cases with hypertrophic scars having been carefully excluded. These scar keloids appeared from one to six months after the bombing, with 100 out of the 210 appearing during the second and third months.

In a study of 501 highly selected survivors reporting to out-patient clinics of Hiroshima hospitals in November and December, 1946, Lt. (jg.) Fred M. Snell (MC) USNR found that 258 had sustained burns, and, of these, 203 (78.7 per cent) showed scar keloid formation in varying degrees.[6] In addition, there were nineteen patients who had developed scar keloids secondary to injuries other than burns.

MICROSCOPIC OBSERVATIONS

A total of eighty-one specimens of lesions considered clinically to be scar keloids removed from atomic bomb survivors from March, 1946 to April, 1947 were studied histologically. Also, sections from biopsies from edges of healing burns obtained in October and November, 1945 were examined. Three sections from lesions considered as ordinary burn scars on atomic bomb survivors, three sections of similar lesions on Japanese burned from other causes and four incisional scars (three of them incisional scars following sequestrectomy in osteomyelitis) were studied. Sections from one spontaneous keloid and eleven sections of scar keloids which developed in Japanese burned from other causes than the atomic bomb explosion were also seen.*

Microscopically, it was found impossible to reach definite conclusions as to the specific configuration of keloids. It seemed impossible to distinguish what might be considered as hypertrophic scars from scar keloids, or from any large mass of pure scar tissue, for that matter. Comparison of all specimens showed much variation in details of morphology, distribution and abundance of all structures, the clinical types of lesions being distinguishable, for the most part, only by the quantity of fibrous connective tissue present. There was no evident consistent difference between the spontaneous keloid, scar keloids developing in healed burns of atomic bomb survivors and scar keloids of healed burns of other etiology. It is said that in the early stage of true or spontaneous keloids, normal tissue is seen in the papillary layer of the dermis above the "tumor mass." In both types of keloid formation the growing mass of tissue is said to be formed in what may be considered as the lower strata or reticular layer of the dermis.[7] However, from this present study one can only agree with Heidingsfeld who concluded in 1909 that after a review by differential histopathology of the character of the location of the tissue of the lesion, preservation or absence of overlying papillae, elastic fibers, hair follicles and glandular structures, the arrangement and distribution of the fibrous tissue, vascular changes and relationship to blood vessels, it is impossible to distinguish idiopathic keloids, scar keloids, hypertrophic scar or ordinary scar tissue.[8] (Figs. 8 to 12.)

The scar keloids were seen to be composed of massive quantities of interlacing collagenous connective tissue fibers, between which were connective tissue cells varying in concentration with the specimen. In general, the connective tissue cells were relatively numerous, there being a gradual decrease with age of the specimen, but this was not consistently true. The cells in many cases appeared long and oval in shape with large vesicular nuclei. In other cases the cells were more spindle-shaped and smaller in size. No conclusions could be reached as to the presence of any

* The U. S. Army 406th General Medical Laboratory in Tokyo very kindly prepared these sections for microscopic study.

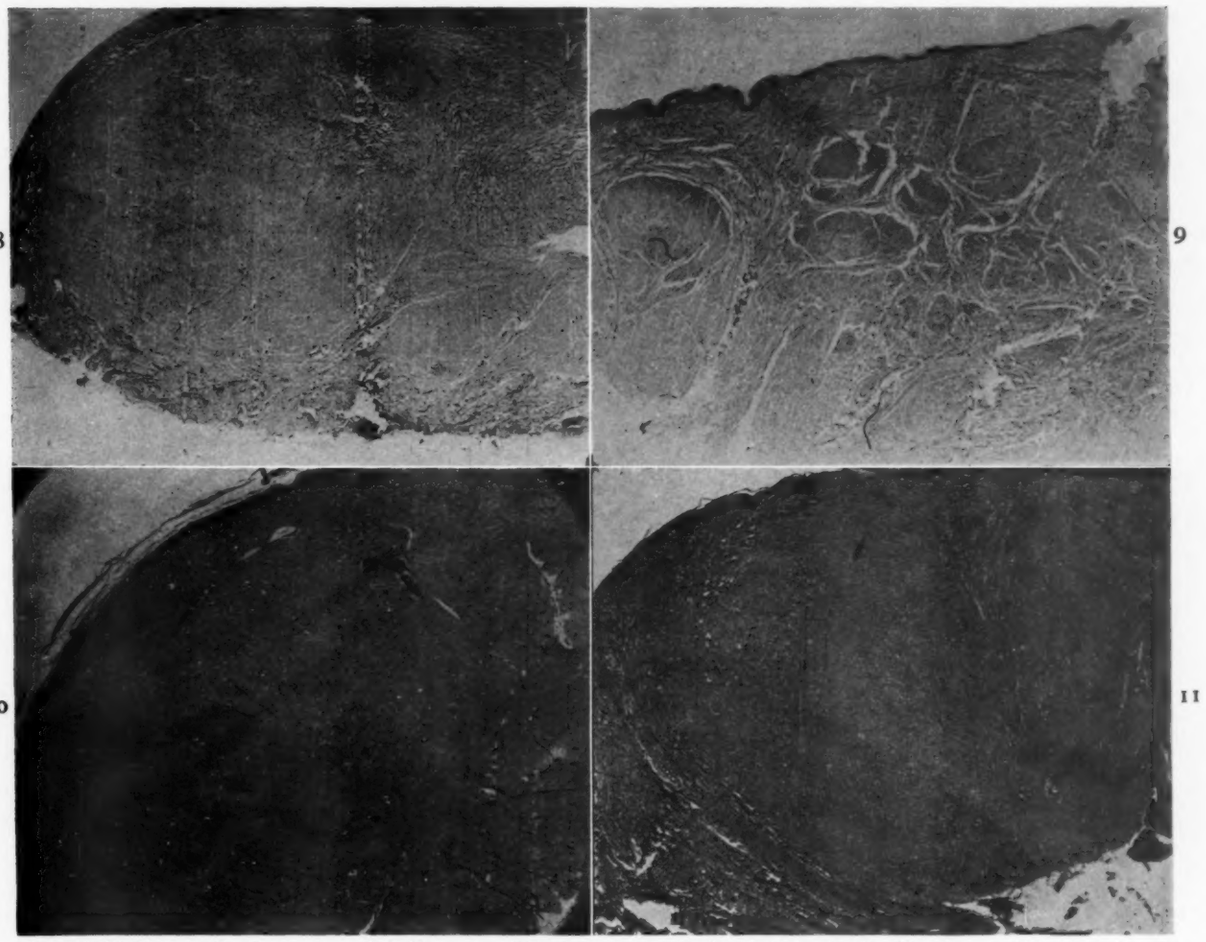


Fig. 8. This is a section from a scar keloid removed January 21, 1947, from the neck of a fifteen year old atomic bomb survivor of Hiroshima. This section is taken from the edge of the lesion, the edge being shown on the left side above. It is composed largely of a large dense mass of collagenous fibers. This demonstrates the manner in which this mass compresses slightly the narrow layer of tissue between it and the epidermis above and compresses and slightly bulges into normal appearing tissue at the edge of the lesion (shown at the left side of the illustration). The mass also seems to be distinct from a thin layer of tissue separating it from the subcutis. In this latter thin layer are seen sweat glands. The overlying epithelium is thin and lacks rete pegs. This illustrates a pattern frequently seen in the sections of scar keloids studied; hematoxylin and eosin, × 14½. (Neg. No. 101064.)

Fig. 9. This is a section from a scar keloid removed from the dorsum of the hand of a 20 year old Hiroshima atomic bomb survivor on 30 January, 1947. This section illustrates another pattern seen in the scar keloids studied. It is composed of collagenous fibers arranged as a number of large relatively dense bundles, between which are running interlacing collagenous fibers in a more loose arrangement. The epithelium is thin and its basal cells are heavily pigmented; hematoxylin and eosin, × 16. (Neg. No. 101065.)

Fig. 10. This is a section from a scar keloid removed July 30, 1946, from a thirty-four year old Hiroshima atomic bomb survivor. This illustrates another pattern seen in the sections studied. The epithelium is thin and lacks rete pegs. The underlying tissue is rather homogeneous in appearance consisting of a large amount of collagenous connective tissue fibers running, for the most part, parallel to the epithelial surface; hematoxylin and eosin, × 18½. (Neg. No. 101077.)

Fig. 11. This section was taken from a lesion considered to be a scar keloid which developed on the chest of a Japanese patient, age twenty-three, burned by an incendiary bomb explosion, not by the atomic bomb explosion. The injury occurred July 23, 1945; the lesion was excised July 4, 1946. This illustration shows an area at the edge of the lesion, the junction with normal appearing skin being seen on the left. The epithelium is not unusual. Large masses of dense collagenous tissue fibers are located in the deeper part of the dermis compressing slightly the adjacent tissue. At the base of the section, just above the subcutis, and in the normal cutis adjacent to the mass are normal skin appendages; hematoxylin and eosin, × 160. (Neg. No. 101076.) (Figures 8 to 11 were made by the Army Institute of Pathology.)

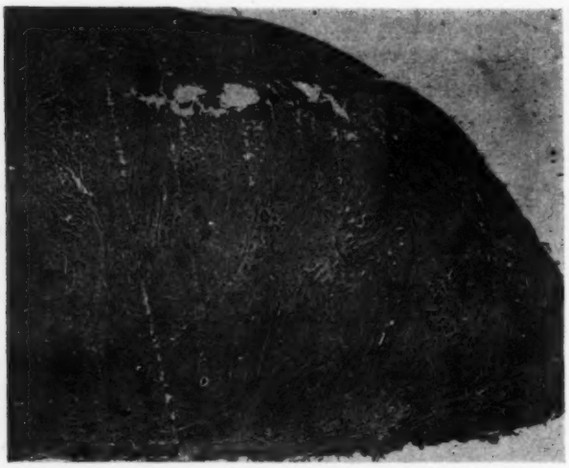


FIG. 12. × 23 magnification. H and E. This is a section from a lesion considered to have been a spontaneous keloid that developed on the anterior chest of a Japanese patient, age thirty-seven. The keloid was said to have been noticed first eight years prior to surgical removal which was done July 12, 1944. This illustration shows an area at the edge of the lesion, the junction with normal appearing skin being seen on the left. The epithelium was not unusual. The mass of tissue was composed of some large collagenous fibers with some bundles of finer fibers more densely packed. (Neg. No. 101075). (Photomcrograph by Army Institute of Pathology.)

specific pattern or configuration of the connective tissue in the various types of lesions. Many appeared as single or several large dense masses composed of interlacing bundles of thick collagenous fibers, these masses occupying what might be considered as the reticular layer of the dermis and bulging into or slightly compressing the thin layer of subepithelial fibrous tissue above (in what might be considered as the papillary layer of the dermis), the normal and scar tissue at the edges of the lesion, and also the normal and scar tissue in or near the subcutis at the base of the lesion. (Figs. 8, 11 and 12.) In other specimens the large quantity of scar tissue was composed of many bundles of dense interlacing thick collagenous fibers running in various directions and embedded in fibrous tissue arranged more loosely. (Fig. 9.) Still another pattern seen in some specimens was that of a homogeneous distribution of interlacing collagenous tissue fibers traveling, in general, parallel to the epidermal surface. (Fig. 10.)

No sections were seen in which elastic tissue was present in the fibrous tissue. Elastic tissue occasionally was seen in tissue just above the subcutis and just below the fibrous tissue mass. In some sections the enlarging growth of connective tissue had apparently enveloped some sweat glands, sweat ducts and occasionally a hair shaft, such structures usually being seen near the edge of the lesion and near adjacent normal dermis. Normal skin appendages as sweat glands were frequently seen in tissue just at the level of the subcutis and just below the fibrous tissue mass. Sweat ducts were seen running through the scar tissue in some of the nonelevated or slightly elevated scars. Vascularity of the specimens varied but, in general, the tissue was not very vascular. Metachromatic staining and early hyalinization of the collagenous fibers were seen in some cases studied.

The epidermis overlying this scar tissue varied in appearance, being most often thin and lacking rete pegs. These latter changes had no constant relationship with the appearance of the underlying connective tissue. The basal cells of the epidermis appeared to contain excessive quantities of pigment in many cases although in other cases they appeared to be completely devoid of it.

Small collections of inflammatory cells were seen in some sections. These included lymphocytes, macrophages, and plasma cells and were usually found as a collar around blood vessels near the periphery of the expanding growth of collagenous fibers or in adjacent normal or scar tissue. Such cells were found occasionally around sweat glands or as independent groups in a small area of tissue or fat necrosis. Foreign body giant cells were seen in several sections around a foreign body or in an area of apparent fat necrosis. It was thought impossible to arrive at any conclusion as to the significance of these findings, as to whether they had a cause or effect relationship or were unrelated to the scar keloid and hypertrophic scar formation.

Sections of forty-one biopsies of very small amounts of tissue taken from the edges of healing burns of atomic bomb survivors at Hiroshima approximately three months after the injury were all found to be composed of granulation or scar tissue homogeneously arranged beneath the epithelium. In twenty-six of the sections there was some evidence of an inflammatory process as indicated by perivascular collections of small focal, or occasionally, diffuse collections of macrophages, lymphocytes and plasma cells. Again, it was deemed impossible to fix any relationship between this finding and scar keloid or hypertrophic scar formation. The final outcome of the healing of the lesions of this group of cases is unknown.

COMMENTS

A high incidence of hypertrophic scars and scar keloids did occur in Japanese survivors of the atomic bombings. What is the significance and explanation of this?

A review of the literature on the subject leaves one confused as to what a scar keloid actually is, what the features which specifically distinguish it clinically and histologically from ordinary scars or hypertrophic scars are and what the etiology and pathogenesis of such a formation is. Some state that scar keloids may be differentiated from hypertrophic scars by the fact that scar keloids extend laterally beyond the limits of the original lesion while hypertrophic scars do not.[7] The clinical and histologic studies presented above indicate that the difference between nonelevated scars, hypertrophic scars and scar keloids is only one of degree of accumulation of fibrous connective tissue.

There are a number of pieces of information which tend to preclude the attachment of any special significance to scar keloid formation in atomic bomb survivors. Scar keloid formation was seen in Japanese burned from other causes than the atomic bomb. Although the incidence of spectacular large scar keloids in such patients did not seem as high as in atomic bomb survivors, some cases were seen that would about equal in severity the most severe cases of atomic bomb survivors. (Fig. 7.)

Hiraga states that according to the hospital records of the Tokyo First National Hospital, 106 patients with recent or old burns have been seen as out-patients or were hospitalized from December, 1946 through March, 1947.[9] Of these, twenty-three were considered as having developed scar keloids while seventy-two were thought to have developed hypertrophic scars. In addition, five atomic bomb survivors who had sustained burns were seen, one of whom was thought to have developed scar keloids.

One of the first questions presenting itself is whether the Japanese people have a predisposition for keloid formation. In general, available information indicates that perhaps they have a slightly greater tendency for keloid formation than the white race, but not so great a tendency as the negro race. Hiruma presents the best information on this subject.[3] In a study of 82,950 patients who came to the Tokyo Imperial University, Dermatology Department, with all types of skin diseases during the years 1930 to 1939, 296 complained of keloids. This gives a ratio of 7.8 per 2,000. In a review of Japanese literature on the subject, he found the highest figure of 8.7 per 2,000 given by Yamazaki and the lowest figure of 2.9 per 2,000 given by Ogata, Otani, and Hata. These figures then may be compared with those of Hazen who found a ratio of one case of keloid in 2,000 white patients and fourteen (later twelve) in an equal number of negroes.[10,11] Fox found three cases of keloid in 8,382 white patients and seventy-six in 11,486 negroes, a ratio of about nineteen negroes to one white person.[12] Matas reported a ratio of negroes to white persons of nine to one.[13] It is to be noted that these figures refer to keloid arising in all types of scars or spontaneously, and the incidence of such keloids is based on groups of individuals with all types of skin lesions. Actually, the many possible variables inherent in studies such

as these make it difficult to compare their results. No statistics could be found as to the general incidence in Japanese people of scar keloid formation in burn scars or the incidence of keloid formation in third degree burns.

Hiruma gives the type of lesion in which the keloids developed in 230 of his cases.[3] Injuries were given as the cause in 120 cases: burns, twenty; surgical operations, twenty-nine; wounds, ten; scratches, four; corrosions, seventeen; and others, ten. There were sixty-eight cases in which a suppurative process (as furuncles) was the original cause. The origin of thirty-eight cases was in lesions of other skin diseases.

Of course, scar keloids do occur in the white race and the term is frequently found in references to the types of scars resulting in untreated severe burns. It is especially interesting to note that in the report of survivors of burns from the Cocoanut Grove disaster treated at the Massachusetts General Hospital, it was found that all patients (seven) with third degree burns not grafted later developed what are called keloids.[14] No patients with third degree burns who were grafted developed keloids. Keloid formation probably was not striking in severity in these cases but at least definitely elevated scar tissue apparently did occur.

It is well known that if third degree burns are permitted to heal independently and are not grafted early, elevated scar tissue or what are called scar keloids do frequently occur.[15,16,17] This is especially prone to occur in cases presenting delayed healing and serious infection of the tissue of repair. It is only during the last few years that a deeper appreciation of the special significance of full-thickness burns has arisen. Cope et al. stress the importance of grafting these burns as soon as possible after the occurrence of the injury and the advisability of grafting upon the tissue at the base of the excised necrotic tissue, not grafting upon granulation tissue.[18] They illustrate a case in which one leg was covered on the seventh day with sheet grafts after surgical excision of the slough of the third degree burn. The other leg was grafted on the forty-seventh day with postage stamp grafts on the granulation tissue. After three months it was noted that keloidal tissue had formed diffusely beneath the grafts on granulation tissue whereas no keloid scarring occurred at the location of the sheet grafts except along suture lines. One gains the impression that about all of the hypertrophic scars and scar keloids of atomic bomb survivors occurred in what were deep second or third degree injuries initially or later as a result of infection.

The burns in the survivors were practically all flash burns. Work of Moritz indicates that such burns when extending into the dermis result in a coagulation necrosis of the collagen which heals slowly because of the resistance of the denatured collagen to autolysis and organization.[53] He too notes that the superficial appearance of a burn is not a reliable criterion in judging the depth of a burn and suggests early biopsy of a burn to obtain such information to aid in the proper early treatment.

The burns sustained by atomic bomb survivors certainly healed under conditions excellent for the development of hypertrophic scars or scar keloids. One certainly wonders if scar keloids would have occurred if it would have been possible to graft all full thickness burns soon after the time of the injury. It is said that all burns of second degree or worse became infected and in some cases this resulted in destruction of parts of the skin that had not been injured by the primary burns.[1] The healing of burns are delayed in many cases, with some cases showing incomplete surface healing five months or more after the injury. Some cases also sustained radiation injury which caused a diminished ability to combat infection and to heal and resulted in prolonged healing and increased severity of the wounds. Many cases suffered from marked malnutrition and a poor general condition as a result of the systemic effects of the burns and the lack of food which was

especially pronounced in Japan after the termination of the war. Treatment was minimal and consisted largely of local applications of various greasy ointments and dressings, often by the patients themselves or their relatives. Early skin grafting was not done.

It is impossible to evaluate definitely the significance of the factor of the direct action of ionizing and neutron radiation in the production of these scars. The fact that many patients with scar keloids were located sufficiently far enough away from the center at the time of the explosion so that the amount of ionizing or neutron radiation that they received must have been very low, plus the fact that the burns appeared immediately and were limited for the most part to exposed areas of the skin and were flash burns, tends to minimize the importance of the direct action of these radiations. Any relation between distance from the ground center of the atomic bombings and the frequency of scar keloid formation appeared to be a reflection only of the variation of the severity of the burns. It does seem most probable that any ionizing radiation received by survivors at the time of the bombing was practically all "hard" in character and consisted of gamma rays. Furthermore, it seems that the contribution of residual or long term radioactivity following the immediate explosion in causing or altering the healing of the burns was insignificant.

Why do scar keloids or excessive amounts of scar tissue form? Again, a review of the literature leaves one confused. A number of theories have been advanced, but adequate supporting evidence to prove the etiology or complete pathogenesis of scar keloids is lacking. A number of investigators as Garb and Stone consider hormonal stimulation as being the main or the important cause of keloid formation since the greatest frequency occurs in the second decade of life when an increased glandular stimulation occurs.[2,19] They point out also that keloids are rare in the aged. Geschickter attributes keloid formation to a localized endocrine disturbance.[19] He found increased gonadotrophic substance and estrin on assay of a keloid from the ear. A number of pieces of circumstantial evidence indicate that there are endocrine influences in the tissue regeneration in skin healing.

Marshall believes that keloid formation depends upon excessive serous exudation in wounds, this exerting a chemotropic response from fibroblasts which migrate to the area and proceed to produce an excessive amount of scar tissue.[20–23] In support of this he has shown that repeated intracutaneous injection of serum result, when studied histologically two or three weeks later, in condensation, increase and thickening of subepithelial collagen. Marshall points out that tissue fluid extravasation which occurs in various diseases is followed by connective tissue formation in those areas. Sheehan has used hygroscopic threads introduced at three levels to drain fluid from keloids and reports the occurrence of blanching, subsidence, and pliability of the scar, the excision of which can be accomplished subsequently without recurrence.[54]

Glücksmann considers the formation of hypertrophic scars and scar keloids as a special type of foreign body reaction occurring in sensitive persons.[24] He studied serial biopsies of these lesions from about seventy patients at intervals of one week to several years after injury. The foreign bodies were considered to be extrinsic, as dust particles, but more often intrinsic, as keratinized cysts or abnormal sweat glands. Such bodies were thought to elicit a cellular reaction and perivascular infiltration of fibrocytes. A cellular tissue first formed around the vessels, later changing into the typical tissue of the scar keloid. Krysztalowicz considers both idiopathic and scar keloids to be the result of a chronic inflammatory process such as chronic inflammation of hair follicles and sweat glands.[28]

In a study of burns, Cope and his associates state that "it is an impression that the keloid and scarring are roughly pro-

portionate to the amount of the pre-existing infection."[18] They point out that although chemotherapy will hold invasive infection in abeyance, infection of full-thickness burns is inevitable if they are not grafted shortly after the injury. Gordon and his associates showed that in third degree burns, in contrast to second degree burns, pathogenic organisms seldom behave as innocent residents.[29] A high incidence of severe infections occurred in burns of atomic bomb survivors. Perhaps it would be a mental satisfaction to consider keloids as the result of repeated attempts at repair, each partly frustrated by new injury, so that an excess of scar tissue finally results, but sufficient evidence to support such a hypothesis is lacking. Keloids occur even in skin wounds healing by primary union.[2]

Other investigators have more specifically fixed the origin of keloids as from cells of the adventitia of blood vessels in the corium.[7,25,26,27] Ormsby refers to Warren as stating that keloids begin "by a growth of round cells in the adventitia of the arterioles of the corium. These cells become fusiform, and finally develop into the connective tissue fibers forming the tumor."[7] Ormsby also states that masses of cells usually surround blood vessels extending from the main mass of the keloid and that it is from these cells that recurrences form after supposed removal of the tissue mass. After a histologic study of thirty keloids, three hypertrophic scars and three cases of scars in Japanese subjects, Hiruma concludes that the cells forming a keloid differentiate from the adventitia of blood vessels.[27] He considers the morphology of these cells as being peculiar and found only in keloids and not in hypertrophic scars. He could find no histologic difference between idiopathic and scar keloids. In some of the sections from atomic bomb survivors and from Japanese burned from other causes the general arrangement of fibers was in concentric rings, these occasionally around blood vessels. No impressions were gained in the present study concerning extensions along the course of adjacent blood vessels. Heidingsfeld could not trace the origin of keloid formation to the adventitia or extensions along blood vessels of the corium. He points out that "the tendency for a keloid to become self-limited in its clinical growth and not to involve the deeper subcutaneous structures, also speaks strongly against a vascular origin and an extension along blood vessels. The involvement of blood vessels seems not to be a primary process but a secondary one due to the direct independent extension of the body of the growth proper. In this way the blood vessels become invaded and involved, in the same manner as the hair follicles, sudoriferous and sebaceous glands and other specialized structures of the skin."[3]

Bohrod presents a hypothesis that keloids are now seen more frequently in negroes as a result of the process of sexual selection. This is based on the assumption that a hereditary physico-chemical difference is present in certain individuals causing a tendency for keloid formation. Since in the cult of the African negroes there apparently arose the belief of a magic association between keloid formation and fertility, with the passage of time individuals with a predisposition for keloid formation formed an increasingly greater portion of their population.

There is evidence that the tendency to form keloids not only varies with races but also that there is in some cases a familial tendency.[31,32,33] A number of reports describe cases with hereditary features, but this has never been sufficient to explain such formation in more than a few individuals. The factor of an individual or familial predisposition certainly is to be considered in some cases but the fundamental characteristic which manifests itself by such a predisposition is unknown.

Other investigators have been able to understand keloid formation only as being the result of the occurrence of biochemical and biophysical alterations in the healing process. To explain recurrence of keloids, some investigators must assume that some

chemical change in the local tissues has occurred.[34] Filips believes that the "underlying cause of keloid formation is the hypersensitivity of the fibroblasts and of the vascular endothelial cells to any agent having the power to mobilize those elements in the protein of these cells which induce them to proliferate."[35] He also observes that the "keloidal tendency of the skin varies directly with the amount of tissue destroyed below the papillary layer of the skin and depth of the destroyed tissue, but at the same time large wounds produced by most of the physical and chemical agents and extending into the reticular layers of the cutis or subcutis are potential keloids, regardless of the keloidal tendency of the skin in which the wounds are produced."

Knowledge concerning the biochemical and biophysical factors and processes in the steps of normal wound healing is scanty. Both *in vivo* and *in vitro* studies indicate in early wound healing sequences of, first, active fibroblastic proliferation, followed by a period of relatively slow cellular division during which time the large amounts of collagen are formed.[36,37] What controls the quantity of collagen deposited and the period of time over which this occurs is unknown. The pH of the medium seems to influence the quantity of collagen produced.[37,38] The most favorable pH for collagen deposition is said to be that normally found in the body. Evidence obtained by available methods does indicate that collagen fibrils and fibers are formed extracellularly in the presence of fibroblasts.

Growth stimulating substances and substances stimulating respiration and glycolysis are said to be produced by injured cells according to investigations using ultraviolet radiation to produce controlled tissue injury.[39] Carrel demonstrated a product of leukocytes which excites fibroblastic proliferation and he also observed that extracts of muscle and gland tissue of adult animals stimulate rate of growth of homologous fibroblasts *in vitro*.[40,41,42] Caspe found that creatine increased the rate of growth of a variety of tissue cultures, including fibroblasts.[43] Fell and Danielli believe that alkaline phosphatase is connected with the laying down of collagen.[44] Vitamin C and the body protein levels are considered as important factors and substances in wound healing.[45,46] Tissue tension is a mechanical factor to be considered, and should be remembered in severe injuries where the architectural framework of a large area of tissue is destroyed, as in severe burns. The connective tissue of the body as a dynamic physiologic system itself, changing with age, has increasingly become more apparent in recent years.[47] Present work on hyaluranic acid and related substances should appreciably increase our understanding of connective tissue and its formation.

Several studies of the healing of cutaneous wounds in man further corroborate the findings and impressions gained in this study of the Japanese. Converse and Robb-Smith studied 469 skin graft donor areas, the grafts having been of all thicknesses.[48] They concluded that the quality of the repair was roughly proportional to the rapidity of healing, donor areas healing in six to ten days leaving only a faintly visible scar with a soft pliable base, those healing in fourteen to twenty-one days leaving a more visible uneven scar with a harder base, while those remaining unhealed for a longer period of time often left retracted hypertrophic scars. The rapidity of healing in turn depended upon a number of factors. Donor sites for thin Thiersch grafts healed in six to ten days, for intermediate grafts within fourteen days, whereas healing in areas cut along the level of the base of the dermis required twenty-one to fifty-eight days. In infected donor areas the average healing time was fifty-two days and a rough hypertrophic scar remained. Healing occurred faster where the dermis was thicker and where the skin was loosely bound-down to underlying structures. Illustrative photomicrographs very nicely show the difference between the healed

donor sites for thin and thick grafts, the healed hypertrophic scar at the donor site of a thick graft appearing very similar to the scar keloids and hypertrophic scars studied in the Japanese.

Bishop investigated the regeneration of skin after its removal to various depths in man.[49] He found that if the derma was removed down to the reticular layer, granulation tissue regenerates readily from connective tissue about the hair follicles and full thickness regeneration of the derma occurred. However, if the removal extended into the reticular layer and was sufficiently deep to remove the bases of the hair follicles, scar formation, often pronounced, occurred. The skin may be repeatedly removed from the same area and regeneration as an even sheet of new tissue will occur to full thickness with normal texture and without scarring as long as the removal is above the reticular layer. It was found that histologic differentiation into normal or into scar derma takes place only after healing of the surface epithelium, the fibrotic hyperplasia characteristic of scar tissue occurring after this time. Bishop suggests that there is some tissue element present in the papillary layer which regulates normal growth of connective tissue; if the papillary layer is destroyed, granulation tissue undergoes fibrotic hyperplasia and forms scar.

The natural history of scar keloids in the Japanese is as yet incomplete. It is known that neoplastic changes do occur in such lesions, but in man they are virtually all of epithelial origin, occurring only infrequently and usually after many years and especially in those lesions which healed very late or were prone to recurrent ulceration. Treves and Pack state that about 33 per cent of all scars giving rise to carcinoma are produced by burns.[50] According to Hueper, between 9 and 25 per cent of all cases of carcinoma on the extremities develop in scars of burns.[51] Japanese dermatologists state that skin neoplasms, especially carcinoma of the skin of the face, are less frequent in the Japanese than in the white race.[52]

SUMMARY

A relatively high incidence of scar keloid and hypertrophic scar formation of a severe degree has occurred after healing of flash burns that probably were of deep second or third degree severity and in a people (Japanese), some of whom perhaps have a predisposition for the development of scar keloids. At this late date, the lack of complete, detailed, continuous studies and records on a large group of cases dating from the time of the occurrences of the injury and the large number of variables to be considered render impossible a complete evaluation and understanding of scar keloid formation. The inadequate treatment, poor nutrition, high incidence of severe infection and delayed healing should be considered as important contributing factors which affected the healing process to result in a high incidence of severe keloid or excessive scar formation. Scar keloids were found to occur in Japanese sustaining burns from other causes than the atomic bomb explosion. It would seem most probable that the scar keloids represent no peculiar effect of the atomic bomb explosion. Furthermore, it seems probable that a similar incidence of occurrence of scar keloids could have occurred in burns of the same severity from any other cause under similar conditions during the healing of the lesions in patients having the same general state of health.

One gains the impression that the pathogenesis of keloids can be completely explained only by a better understanding of the detailed biophysical and biochemical processes which occur in the healing of skin lesions and how the initial conditions and possible later alterations in these steps influence the final result of the reparative process. Some individuals may be so constituted that they have a tendency to develop excessive amounts of scar tissue in the healing of wounds. The factors involved

in the etiology of keloids are probably multiple.

It is difficult to arrive at a differentiating working definition of scar keloids. It seems most probable that the differences between ordinary non-elevated scars, hypertrophic scars and scar keloids are only those of degree of amount of fibrous connective tissue produced during the healing process. From clinical data, histologic observations of various types of excised scars and reported experimental studies of the regeneration of skin in man, it would appear that the excess collagen production causing scar keloids and hypertrophic scars occurs when the lesion extends deep in the reticular layer of the dermis and, therefore, occurs usually in burns which extend to this depth initially, or later as a result of necrosis caused by infection or additional trauma. The necessity for early grafting of full thickness burns is again demonstrated. The necessity of preparation for the early care of burns in great numbers of casualties in the event of a catastrophe such as an atomic bombing of a populated area is obvious.

REFERENCES

1. Medical Report of the Joint Commission for the Investigation of the Effects of the Atomic Bomb in Japan, 1946. (To be published.)
2. Garb, J. and Stone, J. Keloids—review of the literature and a report of eighty cases. *Am. J. Surg.*, 58: 315–335, 1942.
3. Hiruma, S. Statistical observations on keloids. *Japan. J. Dermat. & Ven.*, 56: 6–8, 1946.
4. Hatano, S., Uchida, J. and Watanuki, T. Personal communication.
5. Ito, Y. Personal communication.
6. Snell, F. Personal communication.
7. Ormsby, O. S. and Montgomery, H. Diseases of the Skin. P. 696. Philadelphia, 1943. Lea & Febiger.
8. Heidingsfeld, M. L. Keloid: a comparative histologic study. *J. A. M. A.*, 53: 1276–1281, 1909.
9. Hiraga, M. Personal communication.
10. Hazen, H. H. Personal observations upon skin diseases in the American Negro. *J. Cutan. Dis.*, 32: 705, 1914.
11. Hazen, H. H. Syphilis and skin diseases in the American Negro. *Arch. Dermat. & Syph.*, 31: 316–323, 1935.
12. Fox, H. Observations on skin diseases in the Negro. *J. Cutan. Dis.*, 26: 67, 109, 1908.
13. Matas, R. The surgical peculiarities of the Negro. *Tr. Am. S. A.*, 14: 483, 1896.
14. Cannon, B. Procedures in Rehabilitation of the Severely Burned, in Management of the Cocoanut Grove Burns at the Massachusetts General Hospital. P. 103–110. Philadelphia, 1943. J. B. Lippincott Co.
15. Harkins, H. N. The Treatment of Burns. P. 177. Springfield, Ill., 1942. C. C. Thomas.
16. Ibid. P. 286.
17. Davis, J. S. The late plastic care of burn scars and deformities. *J. A. M. A.*, 125: 621–628, 1944.
18. Cope, O., Langohr, J. K., Moore, F. D. and Webster, R. C. Expeditious care of full-thickness burn wounds by surgical excision and grafting. *Am. J. Surg.*, 125: 1–22, 1947.
19. Geschikter, C. F. and Lewis, D. Tumors of connective tissue. *Am. J. Cancer*, 25: 630–655, 1935.
20. Marshall, W. and Rosenthall, S. Pathogenesis and experimental therapy of keloids and similar neoplasms in relation to tissue fluid disturbances. *Am. J. Surg.*, 62: 348–357, 1943.
21. Marshall, W. Production and treatment of scars and keloids. *New Orleans M. & S. J.*, 97: 15–17, 1944.
22. Marshall, W. Fibromatous skin lesions produced by repeated blood serum injections in the human. *Am. J. Surg.*, 69: 338–343, 1945.
23. Marshall, W. Further data on the pathogenesis of fibroblastic neoplasms. *J. M. A. Alabama*, 15: 206–208, 1946.
24. Conference on Wound Healing. *Bull. War Med.*, 4: 252–253, 1944.
25. Hueper, W. C. Occupational Tumors and Allied Diseases. P. 646. Springfield, Ill., 1942. C. C. Thomas.
26. Hintze, A. Keloid tumor and its cure by radiotherapy. *Strahlentherapie*, 57: 224–240, 1934; cited by Filips, L. *M. Rec.*, 150: 370, 1939.
27. Hiruma, S. Histological studies of keloids. *Japan. J. Dermat. & Ven.*, 56: 8–10, 1946.
28. Krysztalowicz, F. Ein Beitrag zur Menntis der Pathogenese der Keloids. *Monatschr. f. prakt. Dermat.*, 49: 81, 1909; cited by Bohrod, M. G. *Arch. Dermat. & Syph.*, 36: 20, 1937.
29. Gordon, J., Hall, R. A., Heggie, R. M. and Horne, E. A. A histological and bacteriological study of healing burns with an enquiry into the significance of local infection. *J. Path. & Bact.*, 58: 51–61, 1946.
30. Bohrod, M. G. Keloids and sexual selection. *Arch. Dermat. & Syph.*, 36: 19–25, 1937.
31. Hiruma, S. Further information regarding keloids. *Japan. J. Dermat. & Ven.*, 56: 4–6, 1946.
32. Bloom, D. Multiple keloids in twin sisters. *Arch. Dermat. & Syph.*, 56: 426, 1947.
33. Gates, R. R. Human Genetics. P. 331. New York, 1946. The Macmillan Co.
34. Smith, E. Reconstructive Surgery, in National Research Council, Div. of Medical Sciences, Manual of Standard Practice of Plastic and Maxillofacial Surgery, Military Surgical Manuals. Vol. 1, p. 36. Philadelphia, 1942. W. B. Saunders Co.
35. Filips, L. Practical observations on the treatment of keloids and potential keloids. *M. Rec.*, 150: 379–383, 1939.

36. Whipple, A. O. Wound Healing, in National Research Council, Div. of Medical Sciences, Burns, Shock, Wound Healing, and Vascular Injuries, Military Surgical Manuals. Vol. 5, p. 177. Philadelphia, 1943. W. B. Saunders Co.
37. Hass, G. and McDonald, F. Studies of collagen. I. The production of collagen in vitro under experimental conditions. *Am. J. Path.*, 16: 525–548, 1940.
38. Karsner, H. T. Human Pathology. P. 15. Philadelphia, 1942. J. B. Lippincott Co.
39. Nutini, L. G. Tissue Repair. In Medical Physics. P. 1581. Chicago, 1944. The Yearbook Publishers, Inc.
40. Carrel, A. Process of wound healing. *Proc. Inst. Med. Chicago*, 8: 62, 1930.
41. Carrel, A. Artificial activation of the growth of in vitro connective tissue. *J. Exper. Med.*, 17: 14, 1913.
42. Carrel, A. and Ebeling, A. H. Action on fibroblasts of extracts of homologous and heterologous tissues. *J. Exper. Med.*, 38: 499, 1923.
43. Caspe, S. The role of creatine in cell growth in vitro and its use in wound healing. *J. Lab. & Clin. Med.*, 29: 483–485, 1944.
44. Fell, H. B. and Danielli, J. F. The enzymes of healing wounds. 1. The distribution of alkaline phosphomonoesterase in experimental wounds and burns in the rat. *Brit. J. Exper. Path.*, 24: 196–203, 1943.
45. Harvey, S. C. Velocity of growth of fibroblasts in healing wounds. *Arch. Surg.*, 18: 226, 1929.
46. Howes, E. L., Briggs, H., Shea, R. and Harvey, S. C. Effect of complete and partial starvation on the rate of fibroplasia in healing wounds. *Arch. Surg.*, 23: 846, 1933.
47. Bogomolets, A. A. Anti-reticular cytotoxic serum as a means of pathogenetic therapy. *Am. Rev. Soviet Med.*, 1: 101–112, 1943.
48. Converse, J. M. and Robb-Smith, A. H. T. The healing of surface cutaneous wounds: its analogy with the healing of superficial wounds. *Ann. Surg.*, 120: 873–885, 1944.
49. Bishop, G. H. Regeneration after experimental removal of skin in man. *Am. J. Anat.*, 76: 153–181, 1945.
50. Treves, N. and Pack, G. T. The development of cancer in burn scars. *Surg., Gynec. & Obst.*, 51: 749–782, 1930.
51. Hueper, W. C. Occupational Tumors and Allied Diseases. Pp. 282–299. Springfield, Ill., 1942. C. C. Thomas.
52. Ota, M., Kawamura, T. and Takayasu, H. Statistical study on 109 cases of skin cancer, treated in the Dermatological Clinic, Tokyo Imperial University, in 18 years (1926–1943). *Japan. J. Dermat. & Ven.*, 56: 10–14, 1946.
53. Moritz, A. R. Studies of thermal injury III. The pathology and pathogenesis of cutaneous burns. *Am. J. Path.*, 23: 915–934, 1947.
54. Sheehan, J. E. Capillary drainage in the treatment of keloidal scars. *M. J. & Rec.*, 129: 548–549, 1929.

TUMORS OF THE CAROTID BODY*

R. A. DONALD, M.D. AND GEORGE CRILE, JR., M.D.
Cleveland, Ohio

BECAUSE tumors of the carotid body are of infrequent occurrence and present unique problems, operation in these cases has resulted in an unnecessarily high morbidity and mortality of the patients. A group of five cases from the Cleveland Clinic is reported to emphasize the peculiar surgical features presented by these tumors and the manner in which they may best be handled.

The gross appearance of the carotid body was first described by von Haller[1] in 1743, and its microscopic characteristics by Luschka[2] in 1862. A tumor of the carotid body was first reported by Marchand[3] in 1891. Scudder[4] was the first in the United States (1903) to resect this type of tumor and to describe it in American literature.

According to reports in the literature[5–7] and in our own experience, the average age of onset of this type of neoplasm is forty years, extremes ranging from the ages of fifteen to sixty-eight with a slight preponderance in the female.

The normal carotid body is approximately 5 mm. in length, reddish-brown in color and enveloped by a fibrous capsule. It contains chromaffin cells and is, therefore, a member of that loosely classified group, the chromaffin system. It is located immediately posterior to the bifurcation of the common carotid artery.

The chromaffin cells are ectodermal in origin, arising from the neural crest in close association with sympathetic cells.[8,9] The special nerve endings (chemoreceptors) found in the carotid body send afferent impulses via the carotid branch of the ninth (glossopharyngeal) cranial nerve.

The principal pathologic condition of the carotid body is tumor formation. The tumors are usually closely adherent to the carotid vessels and surrounding structures and vary in size from 3 to 15 cm. These tumors are richly vascular as one would suspect from their reddish hue and pulsatile nature. Short vessels stem from the carotid arteries directly into the mass, rendering excessive hemorrhage or rupture of a major vessel likely possibilities. Vertical as well as horizontal extension occurs and in many cases the mass presents in the pharyngeal or tonsillar region.

In the benign type of tumor a definite capsule is usually evident. Malignant changes occur in 15 to 20 per cent of patients but metastases are usually confined to the regional lymph nodes and surrounding tissue. Distant metastases are very rare. One of the few proved cases of such a process is included in the following case reports.

The microscopic appearance is characterized by a loose, syncytial arrangement including numerous blood vessels and cavernous sinuses. The cells are polyhedral with granular cytoplasm and chromaffin granules can usually be demonstrated by special staining technics. Some pericapillary grouping of cells occurs.

Schmidt and others[10,11] have demonstrated rather conclusively that the carotid body functions as a chemoreceptor, being sensitive to carbon dioxide increases, anoxemia and the cyanide radical. Stimulation produces an increase in rate and depth of respiration. The chemoreceptor mechanism does not play an active rôle in respiration under ordinary conditions but is a primitive method of preventing respiratory failure as the respiratory center *per se* is not stimulated by anoxia.

SYMPTOMS

The characteristic picture is that of a slowly growing, painless, non-tender mass

* From the Division of Surgery, Cleveland Clinic, Cleveland, Ohio.

in the superior anterior cervical triangle beneath the border of the sternocleidomastoid muscle. The mass is laterally mobile about the axis of the carotid arteries but infiltration of local structures prohibits vertical motion.

Depending upon the degree of vascularity, bruit, thrill and expansile pulsations may be demonstrated. Compression and irritation of local structures frequently occurs, producing sympathetic, vagal and glossopharyngeal nerve damage, resulting in Horner's syndrome, vocal cord paralysis and atrophy of the tongue.[12,13] The carotid sinus syndrome occurs in approximately 3 per cent of cases.[14]

In the differential diagnosis one must consider branchial cleft cyst, tuberculous lymphadenitis, aneurysm, cystic hygroma, lymphoma, metastatic carcinoma or sarcoma, aberrant thyroid tissue and abscess.

TREATMENT

The use of irradiation therapy in the treatment of carotid body tumors has been almost universally unsuccessful. A few reports, however, are encouraging.[14,15] Both benign and malignant varieties respond slightly, if at all, and operative difficulties are further increased when surgery is finally undertaken.

The surgical difficulties encountered are mainly those of inaccessibility of the tumor, many extending beneath the mandible to present in the pharynx or tonsillar fossa and hemorrhage.

The most satisfactory approach has been through a wide incision over the long axis of the tumor with careful sharp dissection along the cleavage plane separating the mass from the adherent large vessels. Local coagulants have proved to be of value in these cases.

Ligation of the common carotid artery is not to be undertaken lightly; a mortality of 24 to 65 per cent[15,16] results from such a procedure. Complications occasioned by cerebral ischemia, such as hemiplegia and aphasia, occurred in over 7 per cent, while damage to the jugular vein, recurrent laryngeal nerve, hypoglossal nerve, facial nerve or sympathetic trunks occurred in 24 per cent of 148 operated patients.[16]

In this group it was necessary to ligate the common carotid artery in approximately 50 per cent of the patients, producing a mortality rate of 30 per cent. About 50 per cent of the survivors suffered permanent brain damage.[1]

Periodic compression of the artery for several weeks prior to operation might feasibly stimulate collateral cerebral circulation to an appreciable extent and decrease the complications resulting from ligation.

From our experience and from case reports in the literature[5,6,16,17,18] it has been brought out that 80 or 85 per cent of carotid body neoplasms are benign and slow-growing. By far the large percentage of the malignant variety recur or metastasize only locally.

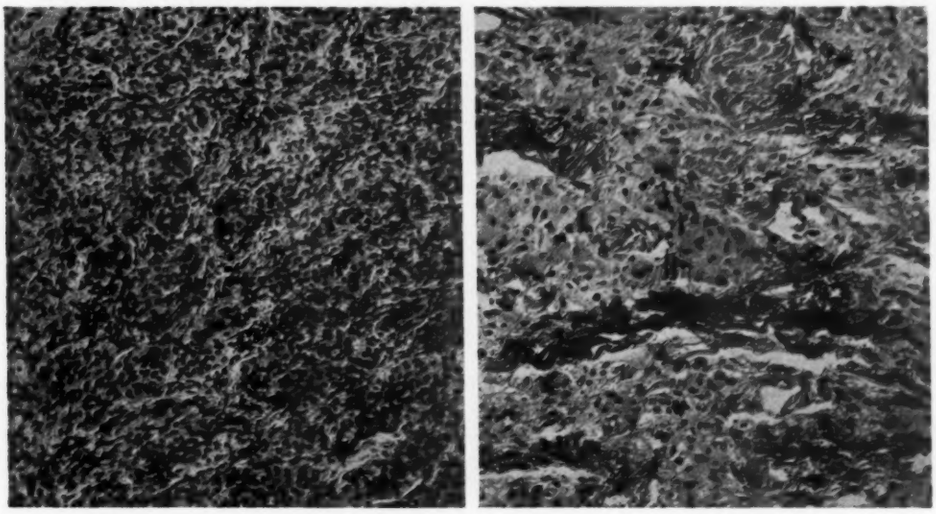
CASE REPORTS*

Case 1 in this series is one of the very few, if not the only case, proved to have had distant metastases from a carotid body tumor. The metastasis in the vertebral bodies was visualized during both operations and biopsies taken each time. The tissue proved to be identical in microscopic appearance to that previously removed at the time of the cervical operation. X-ray evidence of distant generalized bone metastases was also present.

Case 1. A white man, aged twenty-seven, was first seen by Dr. George Crile, Sr., in 1906, complaining of a painless, progressively enlarging left cervical mass. This was resected along with a part of the internal jugular vein. (Fig. 1A.) Recovery was uneventful except for a left Horner's syndrome and twelfth cranial nerve paralysis.

The patient was then free of symptoms until January, 1920, when he developed paraplegia and anesthesia to the level of the umbilicus and was admitted to the hospital. Laminectomy

* Case 1 was partially reviewed and case IV was reported by A. Graham[19] in 1913. They are being represented to reveal more recent developments.



A B

FIG. 1. A, photomicrograph of cervical neoplasm removed in Case I. Note the loose syncytial arrangement. × 100. B, photomicrograph of biopsy specimen removed at time of second laminectomy of Case I. × 100.

revealed an extremely vascular tumor jutting from the fifth and sixth thoracic vertebrae on the left and compressing the spinal cord. The local musculature, bone and soft tissue were extremely vascular. Only part of the tumor could be removed because of the extensive infiltration of bone and soft tissue already present. The patient made an uneventful recovery and was not seen again until his readmission in March, 1931.

At that time he complained of pain and progressive instability of the left knee of four years' duration. Imperfect sphincter control and paresthesia of the left sole had been present for one year. Physical examination revealed a pulsating mass, 6 cm. in diameter, in the region of the manubrium sterni. Distinct bruit was present over this area. Marked tenderness in the region of the right iliac crest and muscular atrophy of the left leg were present.

A left Horner's syndrome, twelfth cranial nerve paralysis (results of resection of cervical tumor), spastic gait, hypesthesia below the eighth thoracic segment and a bilateral Babinski sign were present. Distinct bruit was noted over the site of the laminectomy.

Lumbar puncture at L_5-S_1 revealed a complete block. The fluid was faintly yellow, Pandy 2 plus, protein 130 mg., cells 5, colloidal gold 1112222000 and Wassermann reaction negative.

X-ray examination revealed multiple tumors of the eighth and ninth ribs on the right and of the fifth rib on the left. Rarefaction of the manubrium without definite osteogenesis was present while an osteogenic lesion of the right ilium was noted. X-ray therapy to the bone lesions afforded no symptomatic relief.

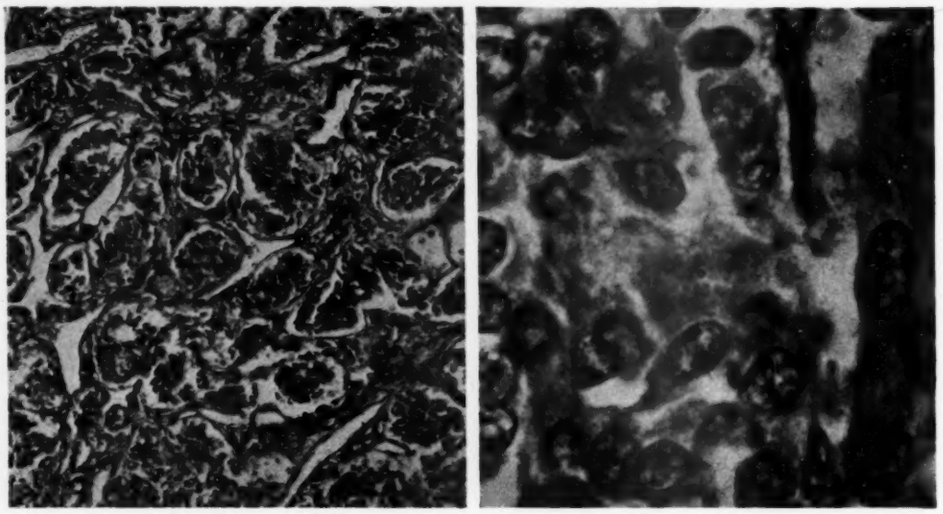
On May 20, 1931, the laminectomy site was reopened and a firm, elastic, dark red mass measuring 5 by 1.5 cm. was found protruding from the bodies of the fifth and sixth thoracic vertebrae. The section of tumor compressing the spinal cord was resected with much bleeding. (Fig. 1B.)

The patient recovered sufficiently to be discharged from the hospital but died on July 29, 1931. Autopsy was not permitted.

CASE II. A woman, aged forty-seven, was first seen by Dr. George Crile, Jr., on July 8, 1946, complaining of a small, moderately firm nodule which had appeared in the region of bifurcation of the left common carotid artery in April of the previous year. The mass had never been tender nor had signs of inflammation occurred but a gradual increase in size had been noted.

Physical examination revealed a mass, 4 cm. in diameter, extending beneath the angle of the mandible on the left. The tumor was laterally but not vertically mobile. There was no bruit, tenderness or sign of inflammation. Pressure over the area produced no alteration in blood pressure or respiration. The remainder of the physical examination and laboratory work was essentially negative.

On August 3, 1946, under intravenous pentothal anesthesia a vertical incision was made over the long axis of the tumor. The mass was



A B

FIG. 2. A, photomicrograph of carotid body tumor removed from Case II. Note the tremendous vascularity and almost sinusoidal character of some of the vessels. Cell grouping and tendency to alveolar formation is rather pronounced. × 100. B, photomicrograph of Figure 2A. Note granular cytoplasm of the cells × 1000.

reddish-brown in color, closely adherent to the carotid arteries in the region of bifurcation and extremely vascular as were the surrounding tissues. No satisfactory avascular cleavage plane could be defined. There was profuse bleeding from the tumor, from the neighboring tissues and from short vessels leading directly from the carotid arteries into the neoplasm. The entire mass was removed and the patient made an uneventful recovery except for transient pain along the distribution of the left posterior auricular nerve.

The gross specimen was globular, rubbery and measured 3 by 2.6 by 1.8 cm. On section the neoplasm was moderately fibrous and firm with a reddish-yellow, irregular central area. Microscopic examination revealed a typical picture of carotid body tumor with large, blood-filled sinuses, loosely arranged stroma and rare mitoses. (Fig. 2.)

CASE III. A white man, aged twenty-seven, was admitted on March 12, 1913, complaining of a small, painless mass which had appeared in the region of bifurcation of the right common carotid artery seven years previously. The mass had gradually increased in size but there had been no pain or signs of inflammation at any time.

Physical examination revealed a well nourished, well developed white man with a mass in the right cervical region extending from beneath the angle of the jaw. The tumor was rounded, smooth, not tender or inflamed and approximately 6 cm. in diameter. It was mobile laterally but not vertically. The mass completely filled the right tonsillar fossa and encroached on the uvula. Slight enlargement of the right submaxillary glands was present. The remainder of the examination and laboratory work was essentially negative.

The tumor was removed by Dr. George Crile, Sr., and the postoperative course was uneventful.

A thin, loose, fibrous capsule surrounded the reddish-brown, hemorrhagic mass. Microscopic examination demonstrated the characteristic picture of carotid body tumor.

CASE IV. A white woman, aged fifty-six, was admitted to the Clinic on July 8, 1929, complaining of a mass which had been present in the left cervical region for fifteen years. The mass was painless, not tender and had gradually increased in size so that during the previous five years some pharyngeal obstruction had occurred.

In 1920 while "scraping mucus" from her throat, she had initiated a severe hemorrhage. After ten repeated hemorrhages the carotid artery was ligated at another hospital. The patient had five rather severe pharyngeal hemorrhages thereafter.

Physical examination revealed an emaciated, white woman who appeared to be in excess of the stated age. A large mass was present in the left cervical region and presented also in the left tonsillar fossa, producing a high degree of

obstruction. The remainder of the general physical examination and laboratory examination were essentially negative.

On July 15, 1929, the patient was anesthetized with nitrous oxide and oxygen in preparation for resection of the tumor. Due to marked respiratory distress a tracheotomy was performed and removal of the tumor was not attempted.

Four days later Dr. T. E. Jones made a transverse incision over the tumor and divided the sternocleidomastoid muscle in the upper third. The tissues surrounding the tumor contained numerous, large tortuous arteries and veins. Considerable hemorrhage was encountered and several transfusions were necessary. The entire mass, measuring 7 by 6 by 2 cm., was finally removed but it was necessary to leave packing in the wound to control the hemorrhage.

The tumor was reddish-brown in color, had a thin capsule with many dilatated blood vessels on the surface and was moderately soft and rubbery in consistency. The cut surface was grayish-yellow in color with many areas of old and recent hemorrhage. A marked fibrous stroma was present. The cut surface was translucent, irregularly lobulated and traversed by many large blood vessels.

Microscopic examination revealed a very vascular bed with loose cellular tissue having no definite arrangement. Some areas of solid clumps of cells with a tendency toward alveolar arrangement were present. Cells were of variable size with deeply staining nuclei and diffusely granular cytoplasm. There was no evidence of nerve trunks or ganglion cells. Areas of extensive diffuse hemorrhage were present in various parts of the tumor. The patient ran a rather stormy postoperative course but recovered completely.

Case v. A white man, aged forty-eight, was admitted to the hospital on August 5, 1924, complaining of a soft mass which had been present in the left cervical region for four to five years. The mass had gradually increased in size, especially during the previous six months, and for the past three to four months moderate tenderness had been present.

Physical examination revealed a rubbery tumor, approximately 6 cm. in diameter, in the area of bifurcation of the left common carotid artery. The mass presented in the left posterior pharyngeal fossa. The mucosa was not affected. The remainder of the physical examination and laboratory findings were essentially negative.

At operation a slightly lobulated mass enveloping the common carotid artery was removed by Dr. George Crile, Sr. The tissue was reddish-brown, somewhat friable and very vascular. On microscopic examination typical features of a carotid body tumor were noted.

Recovery was uneventful except for a minor wound infection.

SUMMARY

1. Removal of tumors of the carotid body is difficult and is associated with high morbidity and mortality.

2. The carotid artery should not be sacrificed unless its ligation is necessitated by uncontrollable hemorrhage.

3. If patience and care are used, most carotid body tumors can be removed without damaging the carotid artery.

4. Irradiation therapy is not often effective in arresting the growth of carotid body tumors.

5. Five cases of carotid body tumor are reported.

6. In one of these cases the tumor metastasized to bones.

Acknowledgment: We are indebted to Dr. John Beach Hazard of the Department of Pathology for reviewing the pathologic material concerned in these cases.

REFERENCES

1. von Haller. Cited by Dickinson, A. M. and Traver, C. A. Carotid body tumors; review of literature with report of two cases. *Am. J. Surg.*, 69: 9–16, 1945.
2. Luschka, H. Ueber die drüsenartige Natur des sagenannten Ganglion Intercaroticum. *Müller's Arch. f. Anat. u. Physiol.*, p. 405, 1862.
3. Marchand. Cited by Gratiot, J. H. Carotid-body tumors; collective review. *Internat. Abstr. Surg.*, 77: 177–186, 1943.
4. Scudder, C. Tumor of the intercarotid body. *Am. J. M. Sc.*, 126: 384–389, 1903.
5. Rankin, F. W. and Wellbrock, W. L. A. Tumors of carotid body; report of twelve cases including one of bilateral tumor. *Ann. Surg.*, 93: 801–810, 1931.
6. Harrington, S. W., Clagett, O. T. and Dockerty, M. B. Tumors of carotid body. *Ann. Surg.*, 114: 820–833, 1941.
7. Peterson, E. W. and Meeker, L. H. Tumors of carotid body. *Ann. Surg.*, 103: 554–571, 1936.

8. Arey, L. B. Developmental Anatomy. 3rd ed., p. 442. Philadelphia, 1934. W. B. Saunders Co.
9. Gray, H. and Lewis, W. H. Anatomy of the Human Body. 24th ed., p. 1298. Philadelphia, 1942. Lea & Febiger.
10. Schmidt, C. F. and Comroe, J. H., Jr. Functions of carotid and aortic bodies. *Physiol. Rev.*, 20: 115–157, 1940.
11. Schmidt, C. F., Dumke, P. R. and Dripps, R. D., Jr. Part played by carotid body reflexes in respiratory response of dog to small changes in carbon dioxide tension in arterial blood. *Am. J. Physiol.*, 128: 1–9, 1939.
12. Coke, M. and Dunlop, H. A. Irritation of vagus by tumor of carotid body. *Lancet*, 2: 1050–1051, 1932.
13. French, H. An Index of Differential Diagnosis of Main Symptoms. 5th ed., p. 179. Baltimore, 1936. William Wood & Co.
14. Gordon-Taylor, G. On carotid tumors. *Brit. J. Surg.*, 28: 163–172, 1940–1941.
15. Bevan, A. D. and McCarthy, E. R. Tumors of carotid body. *Surg., Gynec. & Obst.*, 49: 764–779, 1929.
16. Phelps, F. W., Case, S. W. and Snyder, G. A. C. Primary tumors of carotid body; review of 159 histologically verified cases, report of case. *West. J. Surg.*, 45: 42–46, 1937.
17. Goodof, I. and Lischer, C. Tumor of carotid body and pancreas. *Arch. Path.*, 35: 906–911, 1943.
18. Gilford, H. and Davis, K. L. H. Potato tumors of the neck and their origin as endotheliomata of the carotid body, with an account of three cases. *Practitioner*, 73: 729–739, 1904.
19. Graham, A. Tumors of the carotid body with report of two cases. *Cleveland M. J.*, 12: 537–549, 1913.

Many malignant tumors fail to metastasize. For example, two types of tumors both of which have the same microscopic pattern and react in a similar manner to the tissues in which they originate, may act in manners far different; one may metastasize and the other remain localized. No doubt metastasis is influenced by resistance.

From "Metastases Medical and Surgical" by Malford W. Thewlis (Charlotte Medical Press).

EFFECT OF INTESTINAL GASES UPON BALLOONS OF INTESTINAL DECOMPRESSION TUBES*

MEYER O. CANTOR, M.D., EVERETT R. PHELPS, PH.D. AND ROBERT H. ESLING, M.S.
Detroit, Michigan

THAT rubber membranes were permeable to gases has been known to physicists for over one hundred years. This fact was first noted in 1831 when Mitchell published a paper[1] discussing the permeability of rubber membranes to gases. He noted at that time that the rate of permeability varies with different gases used. Concomitant with the tremendous strides made in the development of synthetic rubbers it was noted that the different rubbers behaved differently to each specific gas. That is, it was soon noted that the permeability of each type of synthetic rubber differed for each kind of gas. Extensive studies were carried on throughout the world with the final result that the permeability of each type of rubber has been charted for each specific gas under many conditions of temperature and pressure.

As a result of studies by numerous workers[2,3,4] it has been demonstrated that the behavior of gases in rubber is similar to that of gases in organic liquids. As a result of this observation rubber may be considered as an organic liquid of high molecular weight. Thus when a gas is brought into contact with a rubber membrane it goes into solution in the rubber on the one side of the membrane and then emerges on the other side by evaporation. It is quite important to note that this process of permeation consists of two separate and distinct factors: first, the solubility of the gas into the rubber and second, the diffusion of the gas through the rubber and its evaporation on the other side of the membrane. In studying this phenomenon it was soon noted that the permeability of any specific gas through a rubber membrane is independent of the presence of any alien gas on the other side of the membrane. In addition, the law of diffusion of gases applies to the passage of the gas through the rubber membrane, namely, any specific gas tends to pass from an area of increased pressure into one of decreased pressure for that specific gas until equal pressures for that gas are obtained on both sides of the rubber membrane. In addition, the presence of other gases on the one side of the rubber membrane has no effect upon the permeability of the rubber to any one specific gas.

The results of these extensive researches were finally formulated into two laws: Henry's law which postulates that the gas first dissolves in the rubber to a degree which is in proportion to the pressure, and Frick's Law which postulates that the gas dissolved in the rubber diffuses in the rubber toward that part of the rubber where the gas is present in a lower concentration; finally, the gas evaporates out of the rubber.

Of all the gases found in the gastrointestinal tract in cases of intestinal distention, carbon dioxide and hydrogen sulfide are apt to be most troublesome for the intubator. The reason for this is that these gases are highly permeable to the natural rubber found in the balloons of the long intestinal decompression tubes in use today. In addition, the concentration of the gases within the bowel is greater than their concentration within the balloon of the intestinal decompression tube. It should be quite evident that although we express all the atmospheric air from the balloon of the intestinal decompression tube before insert-

*This paper is a part of a forthcoming book, "Intestinal Intubation," by M. O. Cantor, M. D. (Springfield Ill., 1948. Charles C. Thomas.)

ing it, nevertheless some atmospheric air remains within the balloon. From the preceding discussion, following the law of diffusion of gases one would expect the carbon dioxide to diffuse through the wall of the balloon into its lumen distending it until the pressure of the carbon dioxide within the balloon equalled its pressure around it, i.e., in the intestinal tract. The same mechanism would of course apply to the other gases found in the gastrointestinal tract. However, as noted previously, the other gases, except hydrogen sulfide, are not nearly as readily diffusible through a rubber membrane. For this reason, the authors began their investigative study upon the balloons of intestinal decompression tubes by using carbon dioxide.

The importance of these studies is quite apparent when one realizes that an increase in the amount of gas within the balloon of the long intestinal decompression tube, where no gas is supposed to be, results in a bulging of the bowel wall around it. If the patient is partially obstructed, a ball-valve type of obstruction results from the presence of a distended balloon pushing against the point of obstruction. If the patient is suffering from stomal edema at the point of anastomosis, the presence of such a distended balloon would completely obstruct the bowel. On the other hand, when an attempt is made at the removal of a tube with a distended balloon, a tear in the anastomosis may occur if the tube head is distal to the anastomotic site. In some cases, the balloon may become so tremendously distended as to tear the bowel. A case in which the metal tip of a Miller-Abbott tube has perforated the bowel at the point of obstruction has been reported.[5] These accidents, although uncommon, have been noted with long intestinal decompression tubes. A knot formation in the Miller-Abbott tube proximal to the balloon may set the stage for the development of a balloon markedly distended with gas.[6]

As a result of our studies upon the effect of intestinal gases upon the balloons of intestinal decompression tubes, we have succeeded in completely eliminating this complication to intestinal intubation. The construction of the Cantor tube lent itself very well to preventing this complication simply and easily; whereas the use of the Miller-Abbott tube, which depends upon an air-filled balloon alone, cannot be so treated to prevent the introduction of gas into the balloon if the channel for inflation becomes obstructed. In the use of any other tube depending upon mercury for its downward passage, prevention of the intake of gas by the balloon is possible as we shall demonstrate in our experimental studies.

EXPERIMENTAL STUDIES

The gas used in our studies was carbon dioxide because, as noted, it is the most diffusible through rubber membranes and because its concentration within the bowel increases with the duration of the bowel obstruction. We tested this gas with all the commonly used types of intestinal decompression tubes. The apparatus used to test the effect of the gas upon the balloons of intestinal decompression tubes was a very simple yet effective one. Figure 1 demonstrates the gas cylinder with gauge capable of permitting the gas to enter our pressure chamber "*p*" at a definite rate to compensate for the loss of gas through the rubber connections and the incomplete gas-tightness of our equipment. The pressure chamber "*p*" is then connected to a mercury manometer "*m*" which measures the pressure within the chamber correctly to the millimeter of mercury. After much experimentation we were able to set our flow of gas into the chamber at such a rate as to keep the pressure of the gas in the pressure chamber constant within fairly narrow limits. In this way we were able to subject our tube heads to varying degrees of pressure at room temperature. In order to insure that the chamber was filled with pure gas being tested, at the beginning of each experiment we would place the tube heads within the chamber, place the lid

upon the pressure chamber, then using the blade of a thin knife under the lid we would turn on a full flow of the pure gas into the chamber at high pressure. If this is done for several minutes, the air present in the chamber is forced out through the chink made by the blade of the penknife. At the end of several minutes the gas pressure going into the pressure chamber is reduced and the knife blade is quickly removed. Our pressure chamber now contains a pure gas from the cylinder. We now set the flow of gas into the chamber at such a rate as to keep the pressure within the chamber at any desired level.

The volume of the gas within the balloons was determined by the water displacement method. By immersing our balloons into a measured amount of water in a measuring flask of 250 cc. capacity, we were able to determine rapidly and simply the amount of gas within the balloon. The value obtained for each balloon before being put into the pressure chamber (with balloon empty) when subtracted from the value obtained after removal of the balloon from the pressure chamber would be the amount of gas taken up by the balloon in cubic centimeters.

In using all three types of intestinal decompression tubes commonly used today, we noted first that the balloons were all of latex rubber so that the diffusibility of any specific gas through this specific rubber should be the same under the same conditions. However, on measuring the thickness of the walls of the balloons used with the Miller-Abbott and Harris tubes, we found them to be 0.006 mm. thick. The thickness of the wall of the Cantor tube ranged from 0.024 mm. in its middle to 0.040 mm. at the base and neck. In addition, the Cantor tube and the Miller-Abbott tube both present balloons about 2½ inches long with the diameter of the Miller-Abbott tube somewhat greater than the balloon of the Cantor tube. The balloon of the Harris tube, however, is 6 inches long and of the same diameter as the Miller-Abbott. Referring to the formula quoted by van

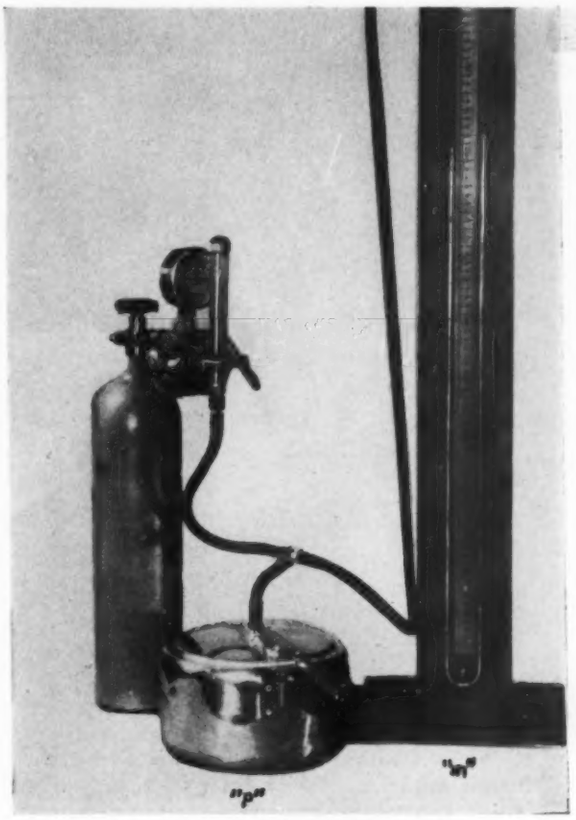


Fig. 1. Apparatus used in conducting the experiments; "p" is gas chamber in which balloons were placed and subjected to a constant pressure of carbon dioxide gas; "m" manometer measuring the gas pressure within the pressure chamber.

Amerongen[7] for the quantity of gas permeating through a rubber membrane we find:

$$q = DbA(p1 - p2/d)t$$

Since "d" represents the thickness of the rubber membrane, it would be evident that the balloons of the Miller-Abbott and Harris tubes would be expected to take up more gas than the balloon of the Cantor tube which is almost four times as thick. Moreover, the Harris tube having a balloon 6 inches long would be expected to take up far more gas than any other tube in use today, because the value for "A" which is the area of the rubber membrane is more than double that of either the Miller-Abbott or Cantor tube. In the equation quoted above, q is the quantity of gas permeating through the specific rubber. "D" is the diffusibility of each specific gas

FIG. 2. The balloon containing the mercury also contains a well defined amount of gas. Note position of balloon at the duodenojejunal flexure.

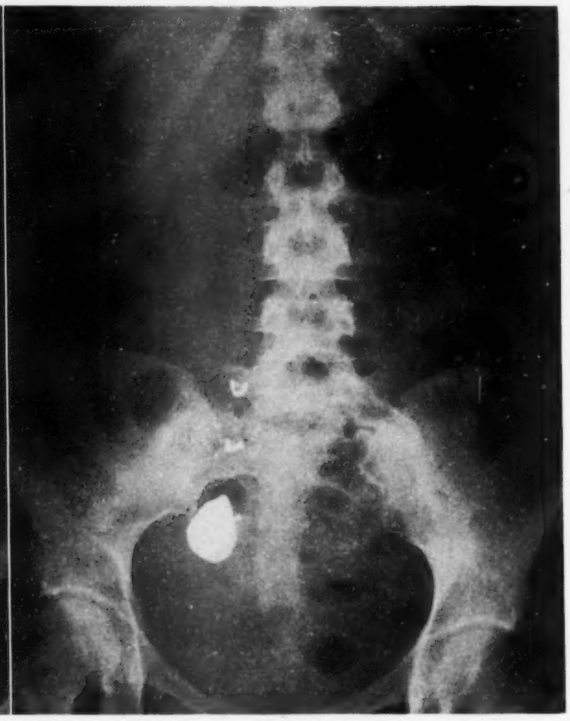


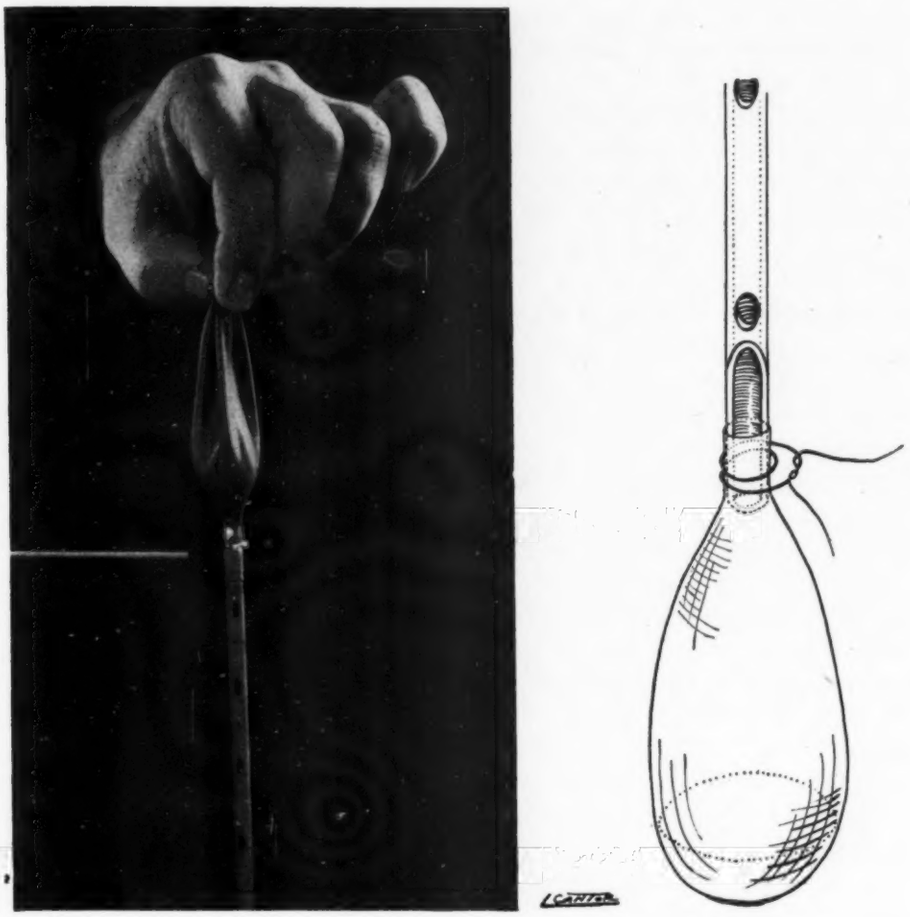
FIG. 3. Note that now the balloon is at the ileocecal valve; note also that the amount of gas within the balloon has diminished.

through each specific type of rubber membrane. This value has been determined for all types of rubber and all types of gas. "*b*" is the solubility of the gas in the specific type of rubber membrane. This value has been determined for all types of rubber and all types of gases which might be found in the gastrointestinal tract. "$p1 - p2$" is the pressure of the specific gas on each side of the rubber membrane; "*t*" is the time for which the rubber membrane is exposed to the gas.

With these preliminary observations in mind, we proceeded to test all the tube heads under varying conditions to check the applicability of the formula quoted by van Amerongen to clinical medicine.

Experiment 1. To note the effects of high pressures upon the balloons of intestinal tubes, we placed the sealed empty balloons into the chamber and raised the pressure of the carbon dioxide to 180 mm. of mercury for twenty-four hours. At the end of this period of time, we found 10 cc. of gas in the balloons. This rapid observation informed us that gas does enter the balloons. We then proceeded systematically to study these balloons under varying conditions.

Experiment 2. For this experiment three balloons from Cantor tubes were used. The balloons were used without being attached to the rubber tubes in order to determine the effect of the carbon dioxide upon the balloons by themselves without tubal attachment. Two of the balloons were tied off at the neck using a silk tie and one balloon was cemented closed at its mouth. In this fashion we could determine whether the presence of the silk tie in any way influenced the permeability of the balloons. It was thought that the tie might injure the rubber so as to increase its permeability at that point. In this experiment a pressure of 37 mm. of mercury was maintained in an atmosphere of carbon dioxide for twenty-four hours. At the end of that period of time it was found that the cemented balloon contained 7 cc. of carbon dioxide whereas the tied off balloons con-



A B

FIG. 4. A, the tie is applied to the shaft of the tube over the point of attachment of the balloon. This tie is tied tight enough to trap the mercury but air can get in and out. To accomplish this, insert a stylet from a No. 22 gauge needle through the last hole into the balloon and tie over it. After tying off the tube remove the stylet. This will leave a small opening through which gas can come out but no mercury. B, sketch of balloon attached to the tube. Note double loop tie being applied to the point of attachment of balloon to tube.

tained 9 cc. for one and 3 cc. for the other. We examined the tied off balloons carefully to determine the reason for the variation in the amount of gas. We concluded from our examination that the tightness of the tie was the important factor. In that balloon in which the tie had been looser the highly diffusible carbon dioxide readily escaped whereas in the very tightly tied balloon it remained trapped. This at once suggested a preventative to the development of gas within the balloon of the Cantor tube when clinically used.

The balloons containing the carbon dioxide were then permitted to lie exposed to the atmosphere to determine how rapidly the carbon dioxide would diffuse out, since the concentration of carbon dioxide in the atmosphere is much lower than that now present in the balloon. At the end of forty-five minutes we found that the cemented balloon had lost 2 cc. of the gas, the tightly tied balloon had lost 3 cc. of its gas whereas the balloon not tied so tightly had lost all of its gas.

The same balloons were permitted to lie exposed to the atmosphere overnight and were rechecked in the morning. At this time no gas was found in any of the balloons.

The practical implications of these observations are apparent. If for any reason

the balloon of the long intestinal decompression tube should become torn off and gas remain trapped within the balloon, by decompressing the bowel the gas would rapidly leave the balloon so that the balloon containing mercury could move down the gastrointestinal tract and so be excreted. Figures 2 and 3 present an unusual case in which this accident occurred. After being in the patient twelve days the balloon was torn from the tube during the removal of the intubation tube. It can readily be seen from Figure 2 that a fairly definite amount of gas is present in the balloon which can be identified as being at or just beyond the duodenojejunal flexure. Figure 3 was taken four days after Figure 2. The amount of gas present in the balloon has decreased, and the balloon containing the mercury has moved down to the ileocecal valve. This experiment was repeated three times with the same results being obtained.

To prevent any possible chance of this happening again, we advise that the tie in the Cantor tube be placed on the shaft of the tube just above its distal end at the point at which the balloon is cemented to the tube. (Fig. 4.) By so doing, it would be almost impossible to tear off the balloon; and if it did occur, the gas and mercury would readily escape without harm to the patient.

Experiment 3. In this experiment ten balloons were used to determine the effect of a pressure of 15 mm. of mercury in an atmosphere of carbon dioxide for four days. Both new and used balloons were utilized in this experiment. This study would demonstrate any changes in permeability that the balloons might undergo by virtue of having been soaked in the intestinal contents of the patient for varying lengths of time as well as the effect of the mercury upon the rubber of the balloons:

Balloon 1 was a new balloon which was tied off with 5 cc. of mercury for five weeks. At the end of this period of time the rubber of the balloon was discolored black. There was no vaporization of the mercury in the balloon since the volume of this balloon and the volume of a new balloon containing the same amount of mercury was exactly the same. At the end of the four days at 15 mm. of mercury carbon dioxide gas pressure, this balloon took up 7 cc. of carbon dioxide.

Balloon 2 had been in the patient soaking in intestinal secretions for twenty-four hours. This balloon was then dried and sealed empty in an envelope for thirteen more days before being used in this experiment. Care was taken to tie off the neck of the balloon tightly and to separate the walls of the balloon so they would not stick. This balloon took up 23 cc. of carbon dioxide in the four-day period at 15 mm. of mercury.

Balloon 3 had been in the patient for five days soaking in intestinal secretions. The balloon was then dried and kept in a sealed envelope for thirteen more days before being used in this experiment. This balloon took up only 4 cc. in four days at 15 mm. mercury. It is apparent from this that soaking the balloon in the intestinal secretion does not increase its permeability but that some other explanation must be sought for the result in balloon 2. We believed that the probable answer was that in balloon 3 the walls of the balloon were squeezed together in an effort to express all the atmospheric air with the result that they tended to stick together so that the two sides of the balloon acted as one membrane with no cavity into which the carbon dioxide could diffuse. This point will be checked again in experiment 4.

Balloon 4 was in the patient for ten days soaking in the intestinal secretion, and the mercury remained in the balloon for a total of thirty-seven days. This balloon took up 15 cc. of carbon dioxide in the four days at 15 mm. of mercury pressure.

Balloon 5 was in the patient for five days and in a sealed envelope for thirteen days more. No mercury was used in this balloon during the test. This balloon took up 4 cc. of carbon dioxide.

Balloon 6 from a Miller-Abbott tube was tied off at both ends without a tube passing through it in an effort to see whether the empty balloon itself would take up any carbon dioxide. We found no carbon dioxide in this balloon at the end of four days at 15 mm. mercury pressure. The walls of the balloon were in close contact with each other because of their thinness. The question arose as to whether this balloon was so highly permeable that it could not retain any carbon dioxide or whether, as in balloon 3, the walls of the balloon being in contact with each other there was no space into which the gas could pass. We, therefore, investigated this point in experiment 4.

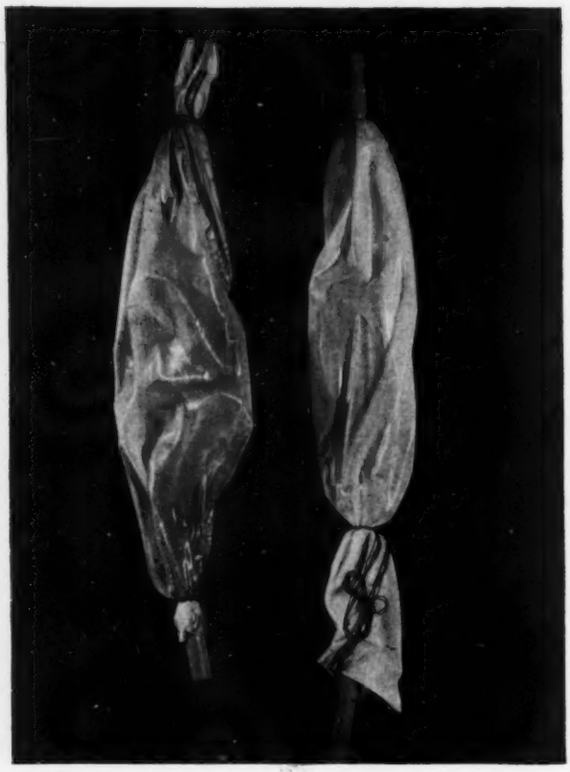
Ballon 7, an empty latex balloon from a Harris tube, was then tied off at each end. This was a new balloon. This balloon did not take up any carbon dioxide. Again the question arose as to whether the balloon was so highly permeable that it could not hold the carbon dioxide or whether the walls of the balloon in contact with each other prevented the gas from entering. This, too, is to be studied in experiment 4.

Balloon 8 was attached to a 2-inch length of tube. Five cc. of mercury was placed in the balloon and the balloon sealed by tying tightly at the point at which the balloon was cemented on to the tube (Cantor). In this way, the tube was tied off so tightly that neither air nor mercury could get in or out. This balloon took up 18 cc. of carbon dioxide in the four-day period at a pressure of 15 mm. of mercury. From this it is evident that the mercury by separating the walls of the balloon creates a space into which the carbon dioxide could diffuse.

Balloon 9 was attached to a 2-inch length of tube and 5 cc. of mercury placed in the balloon. The tube was tied off at the same point as in balloon 8, but the tie was tied only tight enough to trap the mercury but not tightly enough to seal in the air. We could blow air into the balloon and squeeze it out of the balloon but the mercury could not escape. By squeezing all the air out of this tied off balloon and placing it into the same chamber for the same period of time as balloon 8, we found that this balloon took up only 6 cc. of carbon dioxide. Furthermore, when this balloon was immersed in our measuring flask of water to determine the volume of carbon dioxide which it took up, the gas rapidly bubbled out of the balloon due to the slight pressure of the column of water around it.

Balloon 10 was attached to a 2-inch length of tube. Five cc. of mercury was placed in the balloon. The tube was then tied off at the same point as balloons 8 and 9 (at the distal end of the tube just above its terminal end and at the point at which the balloon was cemented on). The double loop tie was again tied tightly enough to seal in the mercury but the air could readily get in and out of the balloon. This balloon was found to take up 8 cc. of carbon dioxide at the end of four days at a pressure of 15 mm. of mercury. This balloon also rapidly lost its carbon dioxide by the slight water pressure incident to measuring its gas volume.

Conclusions from This Experiment. It is evident from this experiment that the length of time that the balloon is permitted to soak in gastrointestinal contents does not affect its permeability, nor does the length of time that the mercury is permitted to remain in contact with the rubber appear to effect its permeability to carbon dioxide. It also suggests that the walls of the balloon must be separated before the balloon will take up any carbon dioxide although this point will be checked in experiment 4. The most important observation in this experiment is that when the tie is applied tightly enough so as to trap the mercury in the balloon, yet not so tight that air can get in and out of the balloon, a markedly reduced volume of carbon dioxide is taken up and this small volume is rapidly lost with the slightest pressure. Clinically, a practical application of this point would be the application of the tie in the Cantor tube to the point just above the terminal end of the tube at which the balloon is



A B

FIG. 5. Balloons of Harris tubes. A, balloon containing mercury; B, no mercury in this balloon. Note that both balloons contain gas.

FIG. 6. Balloon of Miller-Abbott tube; note gas in balloon.

cemented on. (Fig. 4.) If this tie is tied tightly enough to trap the mercury but not completely occlude the tube so that air can get in and out, not only will such a tube take up a very small amount of gas if exposed to such high pressure, but the contraction of the bowel wall upon the balloon and the pressure of intestinal secretions would promptly empty the balloon of all gas. In this fashion by applying one tie in this way, it would be impossible for any gas to remain trapped in the balloon of the Cantor tube. This same point might be utilized in other types of tubes that depend upon mercury alone to carry the tube head downward. It would not be used in the Miller-Abbott tube in which air alone is used to fill the balloon or in any air and mercury tube as such tube heads must be airtight. In the Miller-Abbott tube, however, the double lumen which permits aspiration of the distended balloon would furnish an adequate safety valve. In the event that the tube became knotted, however, the gas would be trapped and the balloon would then distend markedly.

Experiment 4. In order to determine whether the latex rubber of the Miller-Abbott and Harris tubes with a thickness of 0.006 mm. was so highly permeable to carbon dioxide that it could not retain it or whether the walls of the balloon in experiment 3 were adherent and thus prevented the intake of carbon dioxide, the following experiment was performed:

The balloons were fastened upon rubber tubes exactly as the tube appears for use clinically. All the air was expressed from the balloons and then the tubes with the balloons attached were subjected to a pressure of 34 mm. of mercury in an atmosphere of carbon dioxide for forty-eight hours. At the end of this period of time, the following results were obtained: (1) The Harris tube with mercury in the balloon took up 20 cc. of carbon dioxide. (Fig. 5.) (2) The Harris tube with the

Fig. 7. Balloon of Harris tube containing glass beads. Note large amount of gas in the balloon. This gas was then removed and tube re-tied. This perfused balloon, when subjected to 15 mm. pressure of carbon dioxide, then took up an equal amount of carbon dioxide.

A B C

Fig. 8. Balloons of Cantor tube. A, empty balloon; B, balloon containing mercury; this took up little gas. C, balloon containing glass beads. This balloon took up 17 cc. of carbon dioxide.

balloon empty took up 12 cc. of carbon dioxide. (3) The Miller-Abbott tube empty took up 8 cc. of carbon dioxide. (Fig. 6.) (4) The Harris tube with beads took up 66 cc. of Carbon dioxide. (Fig. 7.)

This experiment shows rather conclusively that the carbon dioxide gas does diffuse through the balloons of the Miller-Abbott and Harris tubes. It also demonstrates that this occurs when the walls of the balloons are kept apart by the shaft of the tube which traverses the balloons. In addition, the presence of an inert substance such as mercury which further separates the walls of the balloons permits a greater amount of carbon dioxide to enter the balloons.

We now subjected the balloons to a pressure of 100 mm. of mercury of carbon dioxide to determine whether any more gas would enter the balloons at that high pressure in a short period of time (twenty minutes). We found that the carbon dioxide did not enter the balloons in the twenty-minute period even at that high pressure. We must conclude from this that the carbon dioxide diffuses into the balloons at a rate such that no increase in the carbon dioxide would be noted at this pressure in the twenty-minute period.

Experiment 5. The purpose of this experiment was to determine whether the mercury caused more carbon dioxide to enter the balloon because of some special effect within the balloon or whether it was merely the inert mass of mercury separating the walls of the balloon which resulted in the increased amount of gas intake as compared with the empty balloons.

In this experiment, we used eight balloons and subjected them to a pressure of carbon dioxide that ranged from 30 to 40 mm. of mercury for forty-eight hours. The following results were obtained:

Balloon 1 was a plain, empty Cantor tube and balloon with all the air expressed from the balloon by rolling up the balloon tightly. This resulted in a close coaptation of the walls of the balloon. At the end of forty-eight hours this balloon had taken up no carbon dioxide.

Balloon 2, a plain empty Cantor tube and balloon, was treated the same as bal-

loon 1. No gas was found in the balloon at the end of forty-eight hours. (Fig. 8.)

Balloon 3: Glass beads in an amount equal to the volume of mercury used was placed in the balloon of the Cantor tube and subjected to the pressures of carbon dioxide as noted. At the end of forty-eight hours 18 cc. of carbon dioxide was found in the balloon. (Fig. 8.)

Balloon 4: Glass beads in an amount equal to the volume of mercury was placed in the balloon of the Cantor tube as in balloon 3. At the end of forty-eight hours 17 cc. of carbon dioxide was found in the balloon.

Balloon 5: Mercury was placed in the balloon of the Cantor tube in an amount equal to the beads and the same conditions used. At the end of forty-eight hours 2 cc. of carbon dioxide was found in the balloon. (Fig. 8.)

Balloon 6: A Cantor tube and mercury in the balloon was utilized as in balloon 5. At the end of forty-eight hours, 2 cc. of carbon dioxide was found in the balloon.

Balloon 7: A Harris tube was used without mercury and subjected to the same conditions. At the end of forty-eight hours this balloon was found to contain 66 cc. of carbon dioxide.

Balloon 7a: A Harris tube with the balloon containing 5 cc. of mercury was subjected to the above conditions. At the end of forty-eight hours this balloon was found to contain 32 cc. of carbon dioxide.

Balloon 8: A Miller-Abbott tube with empty balloon was subjected to the same conditions. At the end of forty-eight hours the balloon was found to contain 10 cc. of carbon dioxide.

The observations in this experiment followed the formula of van Amerongen that the amount of gas that permeated through a rubber membrane is directly influenced by the area of the balloon. Hence, the balloons of the Harris tube took up far more gas than did the balloons of the Miller-Abbott or Cantor tubes. Since the latter two balloons are one-half the size of the balloon of the Harris tube, this result was to be expected. The experiment also showed that mercury as such did not increase the permeability of the balloons. It acted merely as an inert mass keeping the walls of the balloons apart, thus creating a cavity into which carbon dioxide could permeate. The markedly greater amount of carbon dioxide that diffused into the balloons containing the glass beads as compared with the balloons containing the mercury is quite understandable when one considers that by the use of glass beads the walls of the balloon are separated much better and the small spaces between the surfaces of the beads do not permit the walls of the balloons to rest smoothly upon their surfaces. It becomes evident that anything that will effectively separate the walls of the balloons will result in an increased intake of carbon dioxide. Even with the Miller-Abbott and Harris balloons empty the presence of the shaft of the tube passing through these balloons effectively creates a cavity for the intake and storage of carbon dioxide.

Experiment 6. The purpose of this experiment was to determine whether perfusion thoroughly of the balloons with carbon dioxide until their walls were saturated with this gas would prevent the intake of carbon dioxide.

For this experiment eight balloons were employed. These balloons were subjected to 10 mm. of mercury pressure of carbon dioxide for forty-eight hours. This pressure range is well within that found clinically in cases of intestinal distention in humans. The following results were obtained:

Balloon 1: A Harris tube with the balloon containing mercury was found to have taken up 50 cc. of carbon dioxide at the end of forty-eight hours.

Balloon 2: A Miller-Abbott tube was found to have taken up 17 cc. of carbon dioxide at the end of forty-eight hours.

Balloon 3: A Cantor tube containing glass beads in an amount equal to the amount of mercury used was found to

contain 18 cc. of carbon dioxide as the end of forty-eight hours.

Balloon 4: A Cantor tube was utilized with the balloon containing glass beads in an amount equal to the volume of mercury used. This balloon was found to contain 17 cc. of carbon dioxide.

Balloon 5: A Cantor tube was used with the balloon containing 5 cc. of mercury. This balloon took up 6 cc. of carbon dioxide at the end of forty-eight hours.

Balloon 6: A Cantor tube with the balloon containing 5 cc. of mercury was used. This balloon took up 3 cc. of carbon dioxide at the end of forty-eight hours.

Balloon 7: A Cantor tube was used with the balloon empty. This balloon had been perfused and then rolled up to express all the gas preliminary to being tied off. This balloon took up 3 cc. of carbon dioxide in forty-eight hours.

Balloon 8: A Cantor tube was used with the balloon empty. This balloon had been perfused with carbon dioxide and then the gas evacuated by rolling up the balloon and tying off at its neck. This balloon was found to contain 4 cc. of carbon dioxide at the end of forty-eight hours.

The results of this experiment show rather conclusively that perfusing the balloons thoroughly with carbon dioxide so that the wall of the balloon was thoroughly saturated with this gas, did not prevent the permeation of the gas through the wall of the balloon into its lumen. It has demonstrated that the only important antecedent required for the passage of gas into the balloons of intestinal tubes is the presence of any inert mass that would separate the walls of the balloon thus creating a cavity for gas to accumulate. This experiment was repeated three times with the same result.

CLINICAL APPLICATIONS OF EXPERIMENTAL DATA

As a result of our experimental studies we can state definitely that all balloons of long intestinal decompression tubes are permeable to intestinal gases in the fashion as noted by van Amerongen. The permeability for each specific type of rubber membrane and each specific kind of gas has been determined with such exactitude that a formula has been set up. Being reduced to a formula whose factors are known, the quantity of gas that diffused through a specific type of rubber balloon can readily be computed. Carbon dioxide and hydrogen sulfide are the gases most likely to diffuse into the balloons of intestinal decompression tubes because of their high degree of diffusibility and because of the markedly higher concentration of these gases within the bowel as compared with their concentration within the balloon. Nitrogen and oxygen within the bowel do not vary widely from the concentration found within the balloon which contains atmospheric air. As a result the permeation of these latter gases into the balloons of intestinal tubes would not be expected to be very rapid, if at all, because the difference in pressures of these gases within the balloons and in the bowel is not too divergent. Hydrogen sulfide which accumulates in the gastrointestinal tract in a much higher concentration than is found within the balloon of intestinal decompression tubes is a gas which diffuses through the rubber membranes with such speed and so rapidly that it does constitute a problem.

We have noted rather conclusively that perfusion of the balloons with carbon dioxide will not in any way prevent the diffusion of the carbon dioxide through the wall of the balloon and into its lumen according to the law of diffusion of gases.

An absolute prevention to the accumulation of the gas which permeates through the wall of the balloons of intestinal tubes consists merely in applying the tie to the balloon in such a fashion that the mercury remains trapped within the balloon but air can enter and leave. In this case, the slight pressure of the wall of the bowel during peristaltic activity and the pressure of the liquid contents of the gastrointestinal tract is sufficient to evacuate all gas com-

pletely from the balloons. In addition we urge that all balloons be made of neoprene-G. This rubber, neoprene-G, is only 19 per cent as permeable to carbon dioxide as is latex rubber. By these two changes, we can completely prevent any accumulation of intestinal gases within the balloon.

The law of diffusion of gases acting in a medium of a decompressed bowel is an adequate explanation for the rarity of finding gas in the balloons of intestinal decompression tubes clinically. In our experience with the Cantor tube less than 0.2 per cent of the cases intubated demonstrated gas within the balloons. These cases are invariably those in which the tube is kept in a non-decompressed paralytic bowel for longer than five days. This small incidence of occurrence can be completely eliminated in all types of mercury carrying intestinal decompression tubes.

CONCLUSION

1. All balloons of intestinal decompression tubes are permeable to gases, particularly carbon dioxide and hydrogen sulfide, of the bowel when subjected to prolonged intubation.

2. Since the permeability of the balloons is proportional to the area of the balloon, the Harris tube balloons took up far more gas than any other type of balloon.

3. Prolonged soaking of the balloon in the intestinal secretions does not increase its permeability.

4. The presence of the mercury within the balloon for long periods of time does not increase its permeability.

5. The mercury behaves as an inert body within the balloons and keeps the walls apart so that gas can diffuse into the balloons.

6. An absolute preventative to the accumulation of gas within the balloon of mercury carrying intestinal decompression tubes consists merely in tying on the balloon in such a way that the mercury remains trapped but air can get in and out of the balloon.

7. By using Neoprene-G and tying on the balloon of the Cantor tube in this way, gases cannot accumulate within the balloon of the Cantor tube.*

REFERENCES

1. Mitchell, J. K. On the penetrativeness of fluids. *J. Roy. Inst.*, 2: 101–307, 1831.
2. Daynes, H. A. The permeability of rubberlike substances to gases. *Rev. Gen. du Cautchouc.*, 21: 50–56, 1944.
3. Barrer, R. M. Permeation, diffusion and solution of gases in organic polymers. *Tr. Faraday Soc.*, 35: 628–643, 1939.
4. von Sigmund v. Wroblewski. Ueber die Natur der Absorption der Gase. *Ann. phys. Chem.*, 8: 29–52, 1879.
5. Berger, L. and Aches, S. Perforation of the small intestine by the Miller-Abbott tube. *Surgery*, 22: 648–656, 1947.
6. Cantor, M. O. Intestinal Intubation. Springfield, Ill., 1948. Charles C. Thomas.
7. van Amerongen, G. J. The permeability of different rubbers to gases and its relation to diffusivity and solubility. *Rubber Chem. & Technol.*, 20: 494–514, 1947.

* The observations relative to the diffusion of hydrogen sulfide are those of Mitchell.[1] The authors are at present engaged in repeating Mitchell's observations especially noting the effect of the hydrogen sulphide upon the balloons of intestinal tubes.

SURVEY OF SOME ASPECTS OF APPENDICITIS

JAMES Y. McCULLOUGH, M.D.
Surgeon, St. Edwards Hospital
New Albany, Indiana

IF we could return from paradise a hundred years from now and attend a medical society meeting we might well hear a paper on acute appendicitis. Contrary to our thoughts, which at first might be that such a subject has been discussed many times and is one in which we are thoroughly schooled and on which there could be little change, the fact exists that acute appendicitis constitutes more than 50 per cent of the acute abdominal cases admitted to the hospital[1] and that it still carries an unwarranted mortality. Appendicitis is a subject which to the sophomore medical student is a clear-cut disease offering few obstacles in diagnosis and one which to the veteran physician presents difficult problems in differentiation and calls for profound and discriminating judgment. The author does not propose here to review the cardinal symptoms and signs of acute appendicitis nor to review the differential diagnosis.

If the mortality of appendicitis is to be reduced almost to the vanishing point, it is essential that we, as physicians, appreciate the earliest signs and symptoms of the condition. There are two reasons why patients are operated upon late; either the patient may think that the symptoms are not serious enough for medical advice or the medical advisor may think that the symptoms are not typical of appendicitis or not serious enough to demand operation. It is clear that we have no remedy against the first cause, save the education of the public. As long as a stomach-ache calls for a drug store sale of a physic there are going to be a number of late patients with appendicitis and peritonitis admitted to the hospital. In regard to ourselves it is important that we understand that the so-called typical symptoms of appendicitis as given in the textbooks often indicate a somewhat advanced stage of the condition and that it is impossible to say at the beginning of the attack whether it is likely to be mild or severe in type.

It is desirable to diagnose appendicitis before peritonitis has set in or at least before there is any more than that slight amount of congestion of the peritoneum which is commonly associated with any inflammatory process within the gut. The sensory mechanism of the viscera does not allow the patient to localize the pain as that of appendicitis; it is only when inflammation reaches the peritoneum that localization is accurately established.

The different grades of inflammation of the appendix have for many years been well described and understood, although in some quarters there is still a lack of appreciation of the advanced pathological condition often coexistent with initial symptoms. Catarrh of the mucous membrane, parenchymatous inflammation of the whole wall, gangrene of the interior lining or of all but the peritoneal coat, any of these may coexist with symptoms so slight that they may be overlooked by the patient and thought of slight significance by the surgeon. Even rupture of the appendix due to local gangrene may not cause the patient much trouble so long as local adhesions prevent the extension of the mischief. When the appendix ruptures into the general abdominal cavity, in the absence of any protective adhesions or when after being localized the inflammatory process extends, not even the insensitive patient can refrain from seeking advice.

Obstruction of the lumen of the appendix either by concretion, kink, stricture or adhesion is usually accompanied by more acute symptoms. When the appendix

has ruptured the condition is not merely appendicitis but peritonitis, local, diffuse or general as the case may be and the diagnosis to that extent is more complicated. It is here that the case history is frequently of the greatest help in making certain the true cause of such peritonitis.

TABLE I
SURVEY* OF ONE SURGICAL SERVICE 1942 TO 1946. ST. EDWARD'S HOSPITAL

Cases	All Types	Acute Subacute Perforated Abscess	Acute Perforated Abscess	Perforated Abscess	Percentage of Acute Cases Ruptured	Deaths
Entire period of mortality.	616 1.78%	564 1.95%	396 2.02%	118 9.32%	18.6%	11
Before penicillin mortality.	301 2.3%	270 2.6%	183 3.8%	40 17.5%	14.8%	7
After penicillin mortality.	315 1.2%	294 1.3%	213 1.8%	78 5.1%	26.4%	4
Percentage decrease in mortality after penicillin.	47.9%	50%	52.7%	70.9%		

* Two thousand three major surgical procedures; 616 (30.1 per cent) appendectomies exclusive of incidental operations performed in conjunction with other procedures. They were classified as follows: acute 278, perforated 105, abscessed 13, subacute 168, catarrhal 4, mechanical 4 and recurrent 44.

Before leaving general considerations the author would like to say a few words regarding the pelvic appendix. The perforated pelvic appendix is one of the most easily overlooked and therefore, one of the most dangerous conditions which may occur in the abdomen. The early symptoms of an attack of pelvic appendicitis are similar to those which occur when the appendix is in the normal position. While the appendix is unruptured and tense, the pain due to distention and peristalic contraction is definite and severe and is felt in the epigastrium. When rupture occurs the epigastric pain diminishes and the local pelvic peritonitis results on the right side of the pelvis or at the bottom of the pelvis cul de sac. This is usually unaccompanied by rigidity of the lower abdominal wall. The patient may seem better, the symptoms in the upper abdomen have diminished, there are no signs of rigidity of the abdominal muscles and very little indication of trouble in the pelvis. If the history of the pre-rupture symptoms are missed, it may be very difficult to come to the true realization of the cause of the patient's fever. Irritation of the pelvic wall may result in inflammation covering the obturator internus and rotation of the flexed thigh may elicit pain. Irritation of the bladder and rectum may be present. A mass may be palpable through the rectum. In this type of appendicitis the finger in the rectum is as important as the thermometer in the mouth. Intestinal obstruction is especially apt to occur in complicated cases of pelvic peritonitis.

The treatment of acute appendicitis is, as before, surgical but the treatment has not remained static. The principles of physiological chemistry apply here as well as in the patient with acute intestinal obstruction. The febrile patient with furred tongue and pinched facies, who is dehydrated and acidotic must have restoration of his fluid and electrolyte balance. Protein depletion must be recognized or anticipated. The use of amino acids have proven to be of great service in preventing the complications likely to arise in the presence of hypoproteinemia. The introduction of chemotherapeutic agents, particularly penicillin, allows for changes in surgical practice. The technical aspects of the appendectomy have not changed greatly although they vary. The various technics have their advocates because the surgeon may feel that one incision gives less exposure of the peritoneal contents or better exposure of the peritoneal contents, less chance of contamination, less shock, better drainage and better closure than another method.

The enthusiasm which accompanied the advent of penicillin was tempered somewhat in the minds of surgeons who found its limitations in abdominal conditions complicated by the presence of gram-negative bacilli, notably the Escherichia coli.

Penicillin in doses of 30,000 units every four hours intramuscularly appears to be slightly more effective than sulfonamides in controlling infections of appendiceal origin. In general, however, 30,000 units of

penicillin six times daily will not prevent the formation of intraperitoneal abscesses. The penicillin neutralizing function of the Escherichia coli can be overcome by high initial dosage according to Lieut. George Crile, Jr. and Captain James R. Fulton in a report of the U. S. Naval Medical Bulletin.[2] *In vitro* experiments indicate that the colon group of bacilli is not susceptible to treatment with penicillin but clinical evidence is accumulating that the larger doses are effective in controlling mixed infections. These authors recommend 100,000 units given intramuscularly every two hours for two days and then 50,000 units every two hours for two days, followed by 50,000 units every four hours for two days and finally 25,000 units every four hours for two days, a total of 4,500,000 units in eight days. Lieut. Crile and Captain Fulton believe that a conservative attitude toward the complications of appendicitis has been responsible in no small part for the low mortality in their series of patients, and therefore, recommend conservatism and treatment with chemotherapeutic agents in late cases.

The effects of the use of penicillin are well brought out by the following survey of one surgical service* in our hospital consisting of operated cases of appendicitis between May 10, 1942, and August 18, 1946. (Table 1.) During this period there were 2,003 major surgical procedures, 616 or 30.7 per cent of which were appendectomies exclusive of incidental operations performed in conjunction with other procedures. They were classified as follows: acute 278; perforated 105; abscessed 13; subacute 168; catarrhal 4; mechanical 4 and

* The author's.

TABLE II

PERFORATED APPENDECTOMY CASES REOPERATED

Name	Age	Symptoms Days before Admission	Reoperated Days after Appendectomy	Cases for Second Operation	Miller-Abbott Tube	Penicillin	Days of Dismissal after Appendectomy
L. J.	14	1 day	11 days	Intestinal obstruction	Yes	Yes	29 days
A. H.	15	2 days	13 days	Intestinal obstruction	Yes	Yes	28 days
J. S.*	13	1 day	7 days	Mesenteric thrombosis Intestinal obstruction	Yes	Yes	21 days
C. D.	46	2 days	13 days	Generalized peritonitis Dehisence Abdominal wall	No	Yes	50 days
R. C.	37	5 days	3 days	Generalized peritonitis Dehisence Abdominal wall	No	Yes	Death 7 days after appendectomy

* Rheumatic heart disease.

TABLE III

APPENDECTOMY DEATHS

Name	Sex	Age	Day of Symptoms before Admission	Day of Death	Cause	Penicillin
R. B.	Fe	45	3 days	2 days	Peritonitis	No
F. P.	Fe	45	several	3 days	Peritonitis	No
S. H.	Fe	60	7 days	2 days	Peritonitis	No
M. C.*	Fe	32	3 days	8 days	Pulmonary embolism	No
E. C.*	M	62	4 days	14 days	Pulmonary embolism	No
B. T.†	M	76	several	9 days	Pulmonary embolism	No
M. S.	Fe	60	5 days	7 days	Peritonitis	Yes
L. T.	M	68	3 days	12 days	Peritonitis Uremia Nephrosclerosis	Yes
G. W.	Fe	5	several	2 days	Peritonitis	No
P. W.	Fe	11	5 days	35 days	Peritonitis	Yes
R. C.	M	37	5 days	7 days	Peritonitis Chronic alcoholism Dehisence Abdominal wall	Yes

* All cases of death from pulmonary embolism were improving, had the drains removed and were afebrile. Embolism probably arose from a site of phlebothrombosis.

† Gallstone impacted in appendix.

recurrent 44. It may be seen from the table that 18.6 per cent of the acute cases were of a perforated nature. Of the 616 patients of all types during the entire period there was a mortality rate of 1.7 per cent. In the period before June 15, 1944, 301 patients of all types carried a mortality of 2.3 per cent and after penicillin was introduced into this hospital the series of 315 patients of all types carried a mortality of 1.2 per cent. This represented a decrease in mortality after penicillin of 48 per cent. (Tables II and III.)

In those patients with perforation and frank abscess formation, 118 patients for the entire period of the survey carried a mortality of 9.3 per cent. Broken down into patients before penicillin was used, 40 of these patients with perforation and those with frank abscesses carried a mortality of 17.5 per cent. These same patients after penicillin, seventy-eight in number, carried a mortality of 5.1 per cent. The percentage decrease in mortality after penicillin was 70.9 per cent.

Five patients with perforated appendicitis and peritonitis were reoperated upon, two because of intestinal obstruction one because of mesenteric thrombosis with intestinal obstruction and two because of dehiscence of the abdominal wall. Resection of the terminal ileum was necessary in the one patient with mesenteric thrombosis. The Miller-Abbott tube for small intestinal intubation has proven of great value in instances of paralytic and mechanical ileus.

Of the deaths following appendectomy, six were caused by peritonitis; one by peritonitis with nephrosclerosis and uremia; one by peritonitis with chronic alcoholism and three were due to pulmonary embolism. All the patients who died from pulmonary embolism were improving at the time and had had the drains removed. They were afebrile. The embolism probably arose from a site of phlebothrombosis. It was discovered that one of these patients had a gallstone impacted in the appendix.

The clinical effects of penicillin in mixed infections is, therefore, striking and with the larger doses suggested by Lieut. George Crile, Jr. and Captain James Fulton, greater efficacy may be expected in overcoming the penicillin neutralizing function of the Escherichia coli.

REFERENCES

1. Cope, Zachary. Early Diagnosis of the Acute Abdomen. 6th ed., p. 72. New York, 1932.
2. Crile, George, Jr. and Fulton, James R. Appendicitis with emphasis on use of penicillin. Oxford University Press. *U. S. Nav. M. Bull.*, 45: 464–473, 1945.

BEADED WIRE IN TREATMENT OF SLIPPED EPIPHYSIS OF THE HEAD OF THE FEMUR*

PHILIP T. SCHLESINGER, M.D. AND HAROLD T. HANSEN, M.D.
Orange, New Jersey

THERE has been a multiplicity of treatments, operative and conservative, for slipped epiphysis of the head of the femur. Treatment and prognosis have generally varied according to the stage of the condition. In the preslipping stage results have generally been excellent with either conservative or operative treatments. Conservative treatment includes simple bed rest or traction; the operative treatment includes simple surgical procedures such as the drilling operation or the various methods of internal fixation through a lateral approach which avoids the hip joint.

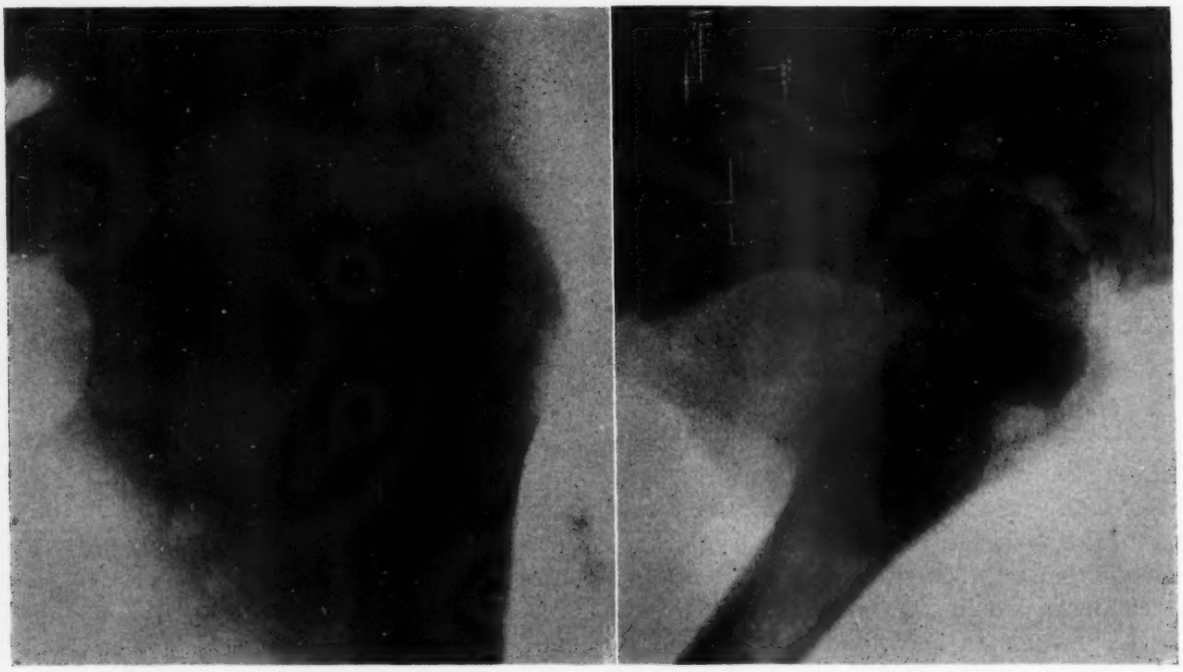
In the late stage when not only has considerable slipping occurred but where the epiphysis has also fused in the deformed position, the accepted treatment is osteotomy, through the healed epiphyseal line, femoral neck or the subtrochanteric region. The former is generally avoided because of the danger of later degenerative changes of the femoral head and articular cartilage.

It is in patients in whom appreciable slipping has occurred and the epiphyseal line is still not closed that most of the difference of opinion exists and in whom many bad late results have occurred. Forcible manipulation and open reduction have given a high incidence of degenerative arthritis after several years whether or not aseptic necrosis had occurred. More recently Howorth and others have advocated a period of waiting either with bed rest and traction or internal fixation until the epiphyseal line has closed and then performing the corrective osteotomy. Results in these patients appear to have shown a distinct improvement over previous ones.

Another treatment in this group of subjects which would seem to offer a method of reduction with less risk is traction. Watson-Jones has recommended a period of ten days to two weeks in heavy traction and Wardle has devised a form of skin traction which allows for a pull in the direction of internal rotation of the hip with the hip being maintained in adduction. Wardle's results in a series of nine patients appear promising.

Skeletal traction allows a much greater pull and would seem to be especially applicable here. The purpose of this article is to present a form of skeletal traction by means of beaded wire through the lower femur, allowing for a strong, continuous pull in the long axis of the femur with an additional pull in the direction of internal rotation. The beaded wire, a Kirschner wire with a metal bead brazed to it, was devised by Thomson and Ferciot for use in fixation of oblique and spiral fractures of the tibia, the wires being incorporated in a cast. Briggs and Keats applied the wire for continuous traction in extracapsular fractures of the hip utilizing the traction in the line of internal rotation to good effect. Our use of beaded wire in slipped epiphysis was directly suggested by this work. The technic of application is simple The wire is applied under sterile conditions with local anesthesia three quarters of an inch above the medial condyle of the femur with a cannulated hand drill. The approach is from the medial side. A small skin incision is made. The wire is introduced until the bead is felt to rest against the femur; i.e., it cannot be pushed further. The bow is then applied and the traction cord attached. A second cord is then attached to the lateral portion of the bow

* From the New Jersey Orthopedic Hospital, Orange, N. J.

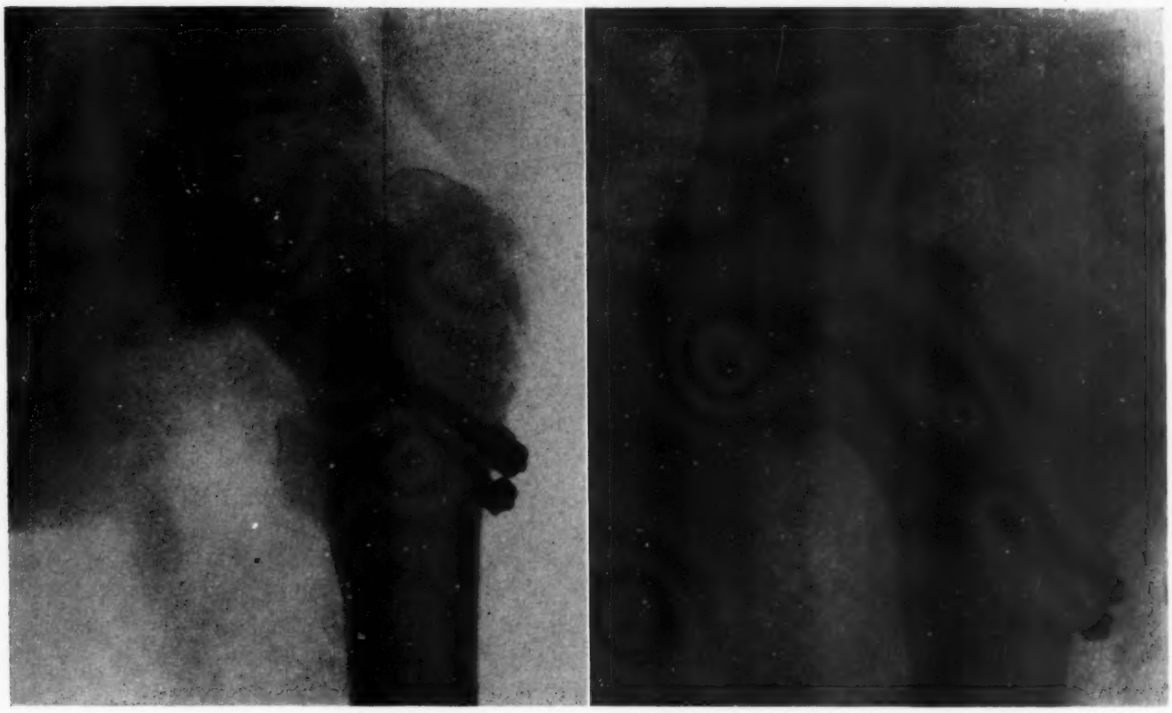


A B

FIG. 1. Case 1. A, anteroposterior view of left hip on admission showing characteristic displacement of capital epiphysis. B, lateral view of left hip taken eleven days after traction was instituted and six days after gentle manipulation showing slight posterior displacement of the epiphysis.

A B

FIG. 2. Case 1. A, anteroposterior view of left hip after fifteen days of traction showing complete reduction. B, lateral view of left hip fifteen days after commencement of skeletal traction.



A B

FIG. 3. Case 1. A, anteroposterior view of the left hip showing Moore pins *in situ* with almost complete closure of the epiphyseal line, two and one-half months following insertion of Moore pins and three and one-half months following start of traction. B, anteroposterior view of the left hip taken June 10, 1946, showing complete fusion of epiphyseal line.

where it grips the wire, the pull being made perpendicular to the femur in an upward direction. This applies force in the direction of internal rotation and the bead prevents slipping of the wire.

We have had four experiences in the use of this technic, as described in the following case reports.

CASE REPORTS

CASE 1. A fifteen year old boy was admitted on May 16, 1945, to the New Jersey Orthopaedic Hospital complaining of pain in the left thigh. In October, 1944, the patient began to experience pain in the left thigh, and walked with a limp. The limp improved after about three months for a short time but then recurred with pain. Pain occurred in the left anterior and medial thigh and was referred down to the knee. There were no constitutional symptoms. His personal and family history were irrelevant.

On examination his general appearance was that of a rather thin boy appearing about fourteen years of age, not looking acurely or chronically ill. The left lower extremity was held in about 40 degrees external rotation, as the patient lay in bed. Passive flexion of the left hip lacked 10 degrees of a right angle.

FIG. 4. Case 1. Lateral view of the left hip taken June 10, 1946, showing complete fusion of the epiphyseal line.

Fig. 5. Case 11. Anterior view of hips showing marked displacement of right femoral epiphysis.

External rotation, passively, was unusually good; internal rotation, however, failed even to reach the neutral point by 10 degrees. Abduction was almost normal. There was no tenderness in the region of the hip or thigh on the left side. There was ½ inch shortening on the left side as measured from the anterior superior iliac spine to the tip of the medial malleolus.

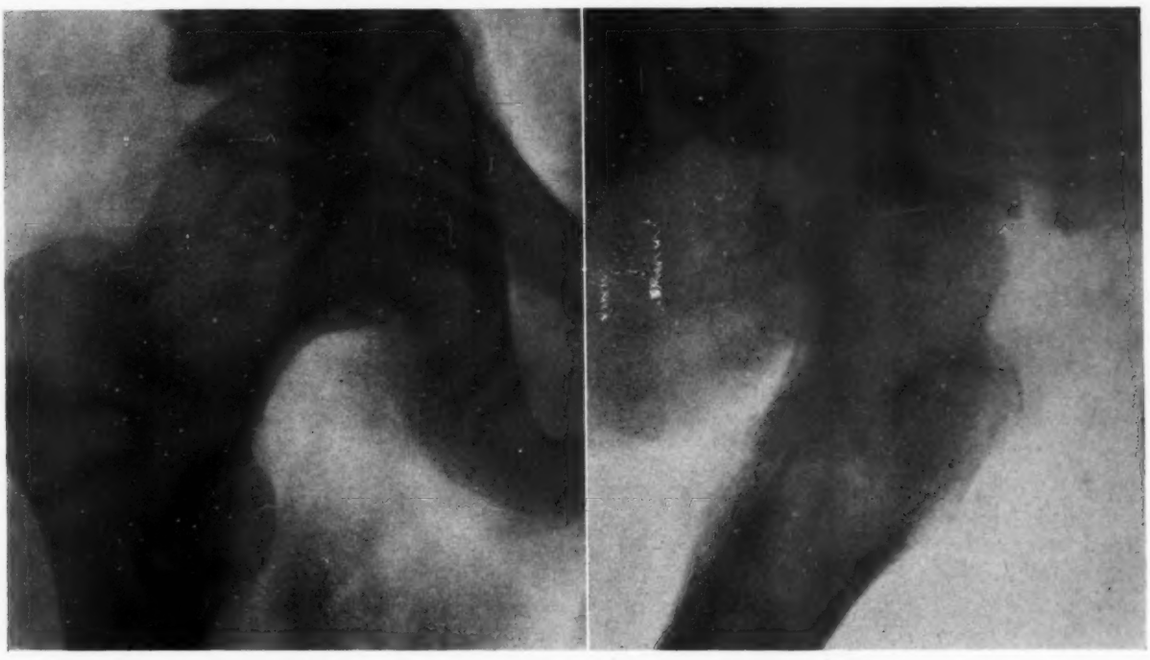
X-ray of the left hip showed characteristic appearance of slipped epiphysis with downward and posterior displacement of the epiphysis.

The following day a beaded wire was inserted in the supracondylar region under local anesthesia with sterile precautions. Following this, traction was made on the spreader. After five days the left hip was gently manipulated, under sodium pentathol anesthesia, after which x-ray showed an apparent partial correction. X-ray taken June 2, 1945, showed apparently perfect correction in both views. Initially he had 20 pounds of direct pull and 10 pounds in the direction of internal rotation, which in a few days was increased to 15 pounds in the direction of internal rotation. Because of his lack of weight (97 pounds) his left buttock was pulled off the bed and for about a week, counter weights were required to hold down his pelvis. Following x-ray on June 2, 1945, direct pull was reduced to 15 pounds and internal rotation was reduced to 10 pounds. The wire was removed on June 8, 1945, after sixteen days because of local infection. On removal of the wire a few drops of thick pus exuded. Wet dressings were applied and penicillin given. The temperature rapidly returned to normal and the infection cleared up completely.

The patient was placed in Russel traction on June 12, 1945. After having been out of traction completely for four days, on June 18, 1945, through a lateral incision three Moore pins were inserted into the head of the femur. Postoperative course was uneventful. The patient

A B

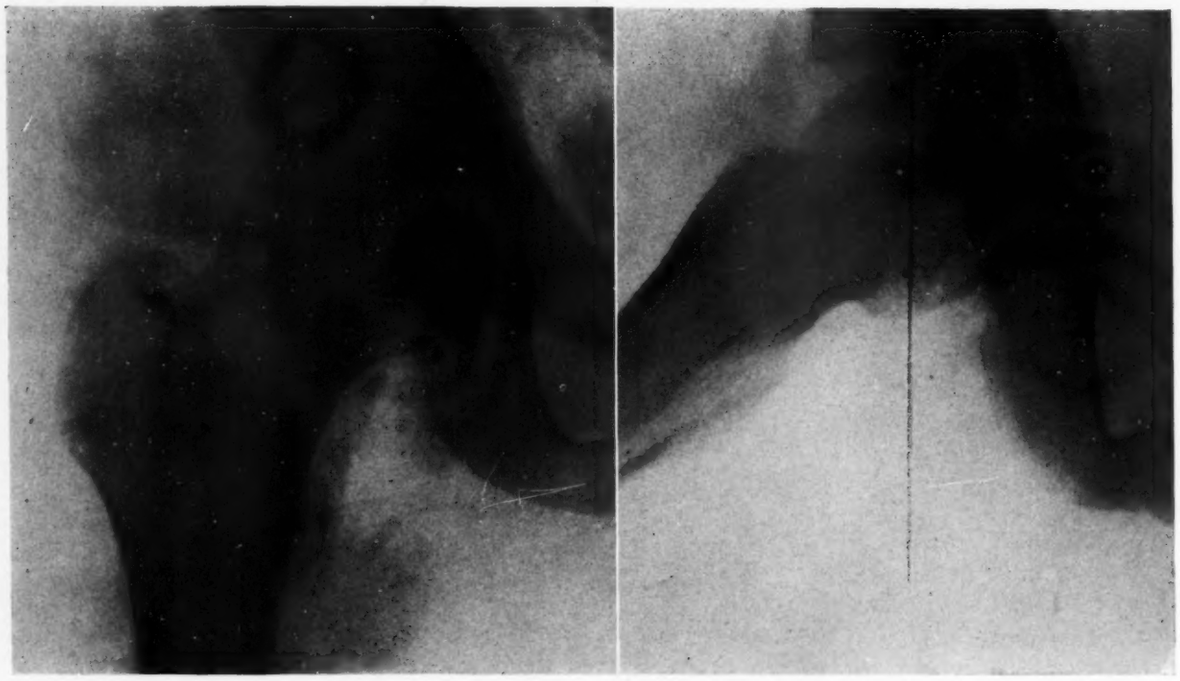
FIG. 6. Case II. A, anteroposterior view of right hip June 4, 1945, following drilling of hip showing complete reduction. B, lateral view of the right hip June 4, 1945, showing complete reduction.



A B

FIG. 7. Case II. A, anteroposterior view of right hip four months later showing complete reduction and beginning disappearance of the epiphyseal line. B, lateral view of right hip four months after admission showing complete reduction.

was discharged on July 5, 1945, in good condition. He was up and about on crutches. Anteroposterior and lateral views of the left hip in the x-ray taken September 5, 1945, showed the three Moore pins in good position. The head was in excellent relationship to the neck. There was no evidence of avascular necrosis; the epiphyseal line showed beginning fusion. External rotation was good; internal rotation to 10 degrees past the neutral point.



A B

FIG. 8. Case II. A, anteroposterior view of the right hip taken June 10, 1946, showing complete fusion of the epiphyseal line. B, lateral view of the right hip taken June 10, 1946, showing complete fusion of the epiphyseal line.

There was no pain; leg lengths were equal. On January 4, 1946, x-ray showed almost complete obliteration of the epiphyseal line. There was no evidence of bony reaction about the Moore pins. The joint space was well preserved.

When last seen on June 10, 1946, the gait was normal. There was no pain. The patient enjoyed full activity. X-ray showed almost complete closure of the epiphyseal line. The head and joint appeared normal.

CASE II. The patient, a sixteen year old boy, was admitted on May 1, 1945, complaining of pain in the right knee, of two weeks duration. About a year before the patient complained of pain in the right knee and had a limp for about two months. This cleared up until about two weeks before admission when the patient again complained of pain in the region of the right knee and began to limp. No constitutional symptoms were presented on either occasion. Personal and family history were irrelevant.

On examination, the general appearance was that of an obese, white boy of sixteen to seventeen years of age, rather pale, not appearing acutely or chronically ill, sitting in a chair in much apparent discomfort. As the patient lay in bed the right lower extremity lay in external rotation. All motions of the hip were restricted. However, internal rotation was not possible even to the neutral point. Abduction was also markedly restricted. Motion of the right hip caused pain referred to the inner aspect of the lower thigh in the knee region. There was shortening of ½ inch on the right.

X-ray of the right hip showed an extreme displacement of the femoral capital epiphysis posteriorly and downward.

The patient was placed in Russel traction to the right lower extremity for six days, after which time x-ray of the hip showed slight, if any, correction of the slipping. The following day, under sodium pentathol anesthesia, the right hip was gently manipulated with traction and internal rotation without apparent correction. A beaded wire was then inserted under sterile conditions into the right femur above the condyles, from medial to lateral. Traction was made postoperatively on the beaded wire as described. Twenty-nine pounds of direct traction was made with 15 to 20 pounds of pull in the direction of internal rotation. X-rays taken five to eight days later showed a partial correction of the slipping. After ten days the right hip was opened through a Smith-Petersen incision and the relations within the acetabulum appeared normal. Check-up x-rays, on the operating table, showed complete correction of the deformity. The incision was closed and a

lateral incision was made, through which multiple drillings were made into the head and neck of the femur. Postoperatively, the patient ran a low grade fever.

The patient was put back in traction on the beaded wire with 20 pounds direct pull and 10 pounds in the direction of internal rotation. After one week this was further reduced to 15 pounds of direct pull and 8 pounds in the direction of internal rotation. After another week it was further reduced to 10 pounds direct pull and 5 pounds in the direction of internal rotation. He was discharged from the hospital on July 5, 1945, in good condition, on crutches. On August 6, 1945, he returned for examination. He complained of no pain, incisions were well healed. He was getting along well on crutches. Flexion of the right thigh on abduction to 90 degrees was normal. Internal rotation of 20 degrees was present. External rotation was normal. X-rays taken September 5, 1945, showed beginning closure of the epiphyseal line with the head in excellent relationship to the neck. On October 2, 1945, the patient had almost full range of motion on the affected side in abduction, flexion and both rotations. Leg lengths were the same. No pain was present and the patient was walking without complaint.

He was last seen on June 10, 1946. He had no complaints. There was no limp. Leg lengths were equal. Motion of the right hip was normal as compared with the left. X-ray showed closure of the epiphyseal line. Head of the femur and hip joint appeared normal.

Case III. The patient, a fourteen year old white male, was admitted complaining of pain in the right hip for six weeks, increased for two weeks. He had had a slipped epiphysis on the left hip three years before.

On examination, the patient walked with a right sided limp holding the right lower extremity in external rotation. The right hip showed flexion to 80 degrees. Internal rotation lacked 20 degrees of neutral. X-ray showed marked backward and downward displacement of the right upper femoral epiphysis.

On May 29, 1946, a beaded wire was inserted into the right femur. The application was unsatisfactory and on June 14, 1946, it was removed and another wire applied. Direct traction of 25 pounds was applied with 10 pounds in the direction of internal rotation.

An x-ray taken July 8, 1946, showed no change in position.

It was then decided to postpone any surgical procedure and to have the patient rest at home. Later osteotomy was contemplated.

Case IV. The patient, a twelve year old white male, was admitted on May 25, 1946. For several months he had reported an occasional sticking pain in the left hip when he walked or ran. Pain disappeared when he sat down or rested. He had pursued his usual activities until three weeks before admission when he developed pain in the left hip at rest.

On examination the patient appeared a rather obese twelve year old boy, eunuchoid, with heavy trunk and poor muscular development. He walked with his left lower extremity in marked external rotation.

As he lay in bed the lateral border of the left foot lay flat on the bed. Internal rotation lacked 10 degrees of the neutral position. There was moderate restriction of abduction and slight restriction of adduction. There was no inequality of leg lengths.

X-ray showed a moderate amount of slipping of the left upper femoral epiphysis.

On May 27, 1946, a beaded wire was inserted into the left femur as described. Traction was gradually increased so that at the end of a week 30 pounds of direct traction and 13 pounds of traction in the direction of internal rotation were being applied. X-ray taken June 8, 1946, showed complete correction. On June 10, 1946, three Moore pins were inserted. The postoperative course was uneventful.

When last seen on November 12, 1947, the patient was symptom-free and there was no restriction of motion on physical examination.

CONCLUSION*

A method of treating some cases of slipped femoral capital epiphysis with the beaded wire has been presented.

Elapsed time is too short to evaluate the end results. However, the excellent correction in three of the four patients and the very good functional result to date in these three patients after a year justify further use of this procedure. The risk involved is small in comparison with the possible benefits. In addition, in the event of failure to achieve correction, the hip itself has not

* Since this article was submitted, several more patients have been treated with this technic and these will be recorded in a subsequent article.

been compromised and an osteotomy later may still produce a good result.

REFERENCES

1. Howorth, M. Beckett. Slipping of upper femoral epiphysis. *Surg., Gynec. & Obst.*, 73: 723, 1941.
2. Watson-Jones, R. Fractures and Other Bone and Joint Injuries. 3rd ed., vol. 2. Baltimore, 1940. Williams & Wilkins.
3. Wardle, E. N. Etiology and treatment of slipped epiphysis of head of femur. *Brit. J. Surg.*, 21: 313, 1933.
4. Thomson, J. E. M. and Ferciot, C. F. Use of beaded wires for internal fixation in certain oblique and spiral fractures of extremities. *Surg., Gynec. & Obst.*, 64: 831, 1937.
5. Briggs, H. and Keats, S. Management of intertrochanteric fractures of the femur by skeletal traction with the beaded Kirschner wire. *Am. J. Surg.*, 71: 788, 1946.

Patients with fractures of the lower limb never should be transported until after splinting has been applied. Hospitalization is necessary for the modern treatment of fractures of the leg. Order X-ray examination before deciding upon the method of further treatment.

From "Fractures and Dislocations for Practitioners" by Edwin O. Geckeler (The Williams & Eilkins Company).

MODIFIED INDIRECT INGUINAL HERNIORRHAPHY

DAVID WEISS, M.D.
New York, New York

THE diagnosis of an indirect inguinal hernia if it is complete and presents itself to the examiner as a mass either in the groin or scrotum is seldom a problem. However, if the condition is incomplete, a bubonocele, that is the protrusion exits through the internal abdominal ring and does not descend the entire length of the inguinal canal or there are no contents within the sac at the time of examination, the diagnosis may be a little more uncertain. When a patient maintains that there was a lump or a child's parent affirms that a mass has been seen one may accept it as presumptive evidence of the existence of a herniation. However, one cannot make such a diagnosis solely on the finding of a dilated or enlarged external inguinal ring.

Henning[8] states that all hernias are congenital in origin with the exception of the traumatic type which shows evidence of injury. This statement requires clarification as invariably the findings of trauma are not visible even at the operating table. It is the author's belief that the potentiality for herniation is congenital rather than profess the characterization that all hernias are congenital. The persistence of the processus vaginalis in itself does not always portend a hernia. It may be described as an enlage in which the final result of protrusion may not necessarily follow. One author voices the opinion that 4.4 per cent of male infants have hernias in the first year of their life; however, most of them disappear after a time.[10]

Erdman[3] maintains that the etiological condition of hernia can be due to one or to a combination of factors. They are a defective closure of the processus vaginalis following the descent of the testis through the canal, sudden increased intra-abdominal pressure and failure in the inguinal shutter mechanism. The latter fault is offered by Keith[10] as the cause of hernia and he further describes it as being formed by the conjoined internal oblique and transversus muscles. Under reflex nervous stimuli these muscles act against the inguinal ligament serving to close the deep abdominal ring.

In the final analysis the causation of inguinal indirect hernia can be accepted to comprise either one or a multiplicity of factors. Beyond all these one must take into consideration the altered evolutionary dynamics of the human species due to their upright stature.

To understand the reasons for the methods employed in the repair and the prevention of recurrences of oblique inguinal hernia a thorough knowledge of the inguinal region is a prerequisite. It is not within the scope of this paper to enter into a complete and detailed anatomic description. Reference should be made to any standard textbook on the subject; however, for the purpose of recapitulation and for some recent concepts the essential highlights are noted. (1) Only the medial portion of Poupart's ligament where it forms the lacunar or Gimbernat's ligament is attached to the pectineal line. Furthermore, Poupart's ligament's only connection to the fascia of the thigh is by a very thin investing fascia;[12] (2) the ligament of Sir Astley Cooper is attached to the pectineal line. With the subject in a standing position this ligament is almost horizontal in position; (3) the normal insertions of the internal oblique and transversus muscles are the pectineal line and not the inguinal ligament; (4) the internal abdominal ring through which the sac protrudes in order that a hernia can be termed as indirect, is situated in the transversalis fascia. Its medial boundary is the inferior epigastric vessels. This anatomic landmark is not a

ring but an hiatus and is funnel-shaped; (5) Hesselbach's triangle is located medially to the inferior epigastric vessels which form its lateral boundary. The other limits of this space are the lateral edge of the inguinal ligament; direct inguinal hernias make their appearance first through this area.

Recurrences of an oblique inguinal hernia are statistically reported to be between 2 and 20 per cent.[17] Consideration of recurrences due to surgical complications as infections and the disruption of the wound are omitted in this discussion. Heath, Brown and Saunders[7] in an analysis of nineteen recurrent hernias found sixteen in which the original sacs were inefficiently removed. This is gross surgical negligence wherein the basic principle of herniorrhaphy was completely ignored, therefore, recurrence should not rightfully be claimed; rather, no surgery for hernial repair has been undertaken. The incision may as well have been located somewhere else on the abdomen unrelated to the inguinal region.

An important cause for failure ascribed to by McVay and Anson[12] is the suturing of the internal oblique and transversus abdominal muscles to Poupart's ligament which is not the normal insertion for this musculature. The failure of the closing or the narrowing of the internal abdominal ring is believed to be another one of the important responsible factors in the production of many recurrences of the indirect variety. It can be assumed that if this hiatus can be completely obliterated, of course entailing the sacrifice of the spermatic cord, an indirect hernia will not recur. This, however, is not suggested for more than one obvious reason.

The surgical procedures which are offered and continue to be offered are legion.[2,4,9,14,15] It is unnecessary to enumerate all of them. The lack of one universal method is due not only to individual preferences but also to the constant search for a repair which will result in a minimal number of failures. For this reason the closest cooperation between surgeon and anatomist is required.

The laparotomy approach by La Rocque and Banergie is cited by Erdman.[3] The sac is dissected and ligated intraperitoneally. Likewise, a similar attack through a midline infra-umbilical incision is fostered by Jennings, Anson and Wright.[9] The hernial sac is dissected retroperitoneally with a high ligation and the internal hiatus is closed by approximation of the transversalis fascia over the opening.

As one peruses the literature on the subject he becomes amazed and arrives at the conclusion that the last word has not been written or said. Furthermore, the impression is gained that all procedures are modifications with attempted improvements of earlier basic herniorrhaphies, such as that of Bassini, Halsted and Wylly Andrews.

Although fundamentally the high ligation and obliteration of the sac are the cardinal therapeutic tenets, most men implement the procedure with technics either striving to close the deep abdominal hiatus or strengthening the floor of inguinal canal. Harkins et al.,[5] after the usual sac ligation, purse-string the transversalis fascia around the spermatic cord. This they follow by suturing the conjoined tendon after the McVay[12] method to Cooper's ligament adjacent to the anterior ramus of the pubis up to the femoral vessels which are about 5 cm. lateral to the pubic spine; the first suture being placed 4 cm. from that point. They vary the procedure of transplanting the cord over the aponeurosis as in the original Halsted operation or follow the typical Bassini operation by leaving the cord in the space beneath the aponeurosis.

Ligation of the sac with suture of its stump beneath the conjoined tendon and tied to the fascial part of the internal oblique muscle is employed by Henning.[8] To augment or fortify the floor of the canal he resorts to a modification of the Andrews' operation. Reliance is placed on a series of special non-absorbable sutures which start

by piercing the lateral leaf of the external oblique aponeurosis as near the symphysis pubis as possible. They then pass under Poupart's ligament across the bottom of the wound and pick up the conjoined tendon and back through Poupart's ligament. Then they traverse the medial leaf of the external oblique fascia and finally pass again through the lateral leaf near the point of commencement. This is followed by fascial imbrication.

Moschowitz[13] in the repair of the femoral hernia makes use of Cooper's ligament as the main binding post. Since then, others[1,12,14,16] are employing this ligament in the repair of inguinal hernia. Mastin[11] in an effort to further barricade the deep abdominal hiatus obliquely incises the internal oblique muscle close to its attachment to the aponeurosis and places the cord through it.

The details of the described operation does not claim entire originality, but rather, combines parts of different procedures which in the author's hands have proved highly satisfactory. It is fairly well accepted that direct and indirect inguinal hernias are two different entities having different dynamics and therapeutic needs. Yet, a patient who has had an indirect herniorrhaphy consisting of a simple ligation and excision of the sac develops a direct hernia—to him the original operation is a failure and he cannot be influenced to view it otherwise. Therefore, the technic presented buttresses the area of Hesselbach's triangle and, in addition, forms another barrier at the internal abdominal ring.

TECHNIC

1. Incision beginning 2.5 cm. below and medial to the anterior superior iliac spine continues parallel from Poupart's ligament to approximately 2.5 cm. proximal to the symphysis pubis.

2. With a finger inserted through the superficial or external ring, the aponeurosis of the external oblique is divided through it and extended laterally towards the anterior superior iliac spine.

3. The inner aspect of the inguinal ligament is cleared with a piece of gauze and Cooper's ligament is isolated and freed of connective tissue.

4. The cord is displaced from the canal, the indirect sac identified and dissected free from the cord structures and followed up as high as possible to the glistening peritoneum.

5. The sac is ligated at its base and the excess removed.

6. With the cord still retracted, the transversalis fascia is plicated and employing the fascia the deep hiatus is made snug around the cord. If the inferior epigastric vessels interfere they are severed and carefully ligated.

7. The conjoined tendon is sutured to Cooper's ligament (absorbable or nonabsorbable material may be used). The first suture includes the tendon and passes through the periosteum overlying the pubic spine and the lacunar ligament. The second suture starts in the conjoined tendon opposite the site of the femoral vessels and with the index finger protecting the vessels the needle impinges Cooper's ligament. Serial sutures, as necessary, are placed between the first and second sutures.

8. A cross or perpendicular (to the fibers) incision is made through the internal oblique muscle at the level of the narrowed deep inguinal ring for approximately 2 cm. The cord is then set in this incised defect and the lateral edges of the cut muscle are re-apposed.

9. Complete transplantation of the cord is accomplished by attaching the medial leaf of the aponeurosis of the external oblique to the shelving edge of Poupart's ligament. The lateral leaf is then imbricated over the medial leaf and the cord is finally replaced on the newly created floor. Or, on the other hand, the cord can be transplanted after performing Step Eight by placing it in the recess and the divided aponeurosis of the external oblique resu-

tured, as in the Bassini operation over the cord.

10. The skin is closed in the usual manner.

COMMENTS

Thirty-eight cases of oblique hernia have been done employing the above technic.

TABLE 1
CASES PERFORMED BY DESCRIBED METHOD

	No. Cases	Six to Twelve Mo. Follow-up	Complications	Failures
Non-absorbable material, cord above aponeurosis	16	12	One wound broke down	0
Absorbable material, cord above aponeurosis.....	18	10	none	0
Absorbable material, cord beneath aponeurosis.....	4	2	none	0

(Table 1.) Of these, twenty-four have been followed for at least six to twelve postoperative months. In one patient the wound broke down and the non-absorbable material which was used was picked from the wound for quite a period of time before complete healing ensued. Nevertheless, the result in this patient was good. Thus far there have been no evidence of recurrence in any of the subjects.

SUMMARY

1. The etiological condition or the origin of the oblique or indirect inguinal hernia is ascribed to certain factors; the persistence of the processus vaginalis, a sudden increase of intraabdominal pressure or the failure of the inguinal shutter mechanism.

2. Some of the causes for failure or recurrence are cited. Either the sac is not completely or satisfactorily ligated, the deep inguinal hiatus is not repaired or Cooper's ligament is not employed as the anatomic insertion of the internal oblique and transversus muscles.

3. Several types of surgical procedures are discussed as to their major purposes.

4. A modified technic is described to help obliterate the deep hiatus and fortify the triangle of Hesselback.

5. Thirty-eight cases were performed using this procedure. Although the follow-up period is admittedly short for complete evaluation, the results have been uniformly satisfactory to warrant the continuation of this method.

REFERENCES

1. Babcock, W. W. *Surg., Gynec. & Obst.*, 45: 534, 1927.
2. Collins, J. D. *Ann. Surg.*, 115: 761–767, 1942.
3. Erdman, S. Christopher's Textbook of Surgery. 3rd ed. P. 1,369. Philadelphia, 1943. W. B. Saunders Co.
4. Graham, H. F. and Martinson, E. O. *S. Clin. North America*, 22: 597–600, 1942.
5. Harkins, H. N., Szilagyi, D. E., Brush, B. E., Williams, R. *Surgery*, 12: 364–377, 1942.
6. Harkins, H. N. and Swenson, Jr. S. A. *S. Clin. North America*, 23: 1,279–1,297, 1943.
7. Heath, N., Brown, J. J. M. and Saunders, K. G. W. *J. Roy. Army M. Corps*, 78: 283–284, 1942.
8. Henning, B. H. *Mil. Surgeon*, 91: 675–681, 1942.
9. Jennings, W. K., Anson, B. J. and Wright, R. R. *Surg., Gynec. & Obst.*, 74: 697–707, 1942.
10. Keith, A. *Brit. J. Surg.*, 11: 455, 1924.
11. Mastin, E. V. *Ann. Surg.*, 115: 756–760, 1942.
12. McVay, C. B. and Anson, B. J. *Surg., Gynec. & Obst.*, 74: 746–750, 1942.
13. Moschowitz, A. *New York State J. Med.*, 7: 396–400, 1907.
14. Neuhof, H. *Surgery*, 12: 128–132, 1942.
15. Stein, H. E. *Am. J. Surg.*, 56: 480–482, 1942.
16. Swenson, S. A. Jr. and Harkins, H. N. *Surgery*, 14: 807–818, 1943.
17. Zimmerman, L. M. *Surg., Gynec. & Obst.*, 71: 654–663, 1940.

NEW TEST IN DIAGNOSIS AND SURGICAL TREATMENT OF VARICOSE VEINS*

TWO HUNDRED VEIN LIGATIONS EVALUATED

JOHN G. SLEVIN, M.D.
Detroit, Michigan

THE modern treatment for primary varicose veins of the long saphenous system with their incompetent valves has been ligation and resection at the japhenofemoral junction followed by insection of sclerosing solution in the varices. The literature is replete with articles stressing the importance of ligating all branches in the region of the fossa ovalis. There has not been the same unanimity of opinion regarding the importance of ligating all incompetent communicating veins or "blowouts."

Some writers minimize the importance of incompetent communicating veins. Heyerdale and Anderson[6] say that these veins are relatively uncommon and think that the rapid filling of superficial veins in the ordinary Trendelenburg Test is caused by a reflux from the lesser saphenous vein and not from incompetent communication veins. Luke,[9] on the basis of venography studies, claims that incompetent communicating veins are very rare and unimportant. Other very competent investigators, notably Pratt,[15] Mahoner and Ochsner[12] and Linton hold quite the opposite views, as do most specialists in this field. Dean and Dulin[3] list them as the primary cause of recurrence.

Our experience has proved that "blowouts" are the chief cause for recurrence of varicosities. We found that whenever a "blowout" was overlooked, injections of sclerosing solution would not obliterate the vein fed by the perforator. Back flow through the incompetent perforator either prevented a firm sclerosis or caused recanalization.

After Mahoner and Ochsner[11] published the account of their comparative tourinquet test in 1936 we used it to advantage to discover "blowouts." The comparative tourniquet test depends upon emptying of the superficial veins through the deep system (modified Perthes test). It only indicates the segment of the leg or thigh involved. For this reason others have introduced modifications of the standard Trendelenburg test to locate more accurately the site of "blowouts." Pratt's[14] two tourniquet technic introduced in 1939, was the first of these. McCutchen,[13] Lyall[10] and others have used two tourniquet modified Trendelenburg tests for the same purpose. All such tests depend upon trapping the "blowouts" and must be repeated a number of times.

Seeking a more accurate and less time-consuming method to locate incompetent communicating veins, Dr. Don McLean of our clinic suggested a modification of the Brodie-Trendelenburg test. In a simple manner this test simultaneously determines both the presence and site of a "blowout" and the type of Trendelenburg reaction. We have named this the "multiple tourniquet test." A search of the literature fails to reveal any other report of a multiple tourniquet test.

The multiple tourniquet test was mentioned by the author in 1940,[18] but not stressed, as we had insufficient data to substantiate its value. We have used it since 1939 and now have ample clinical proof of its usefulness.

MULTIPLE TOURNIQUET TEST

This test is done as follows: The patient lies on the examining table with the lower

* From the Peripheral Vascular Clinic, The Grace Hospital, Detroit, Mich.

extremity elevated until the superficial veins are emptied. Tourniquets are placed about the upper, middle and lower thigh and at least one below the knee. When the patient stands the tourniquets are removed from below upward within thirty-five seconds. A rapid filling of any segment before the highest tourniquet is removed indicates a Trendelenburg double positive reaction. The segment is noted and the test repeated observing the exact location of the "blowout." This is marked with a silver nitrate stick. Such marking remains visible for several weeks and will not wash off when the site is prepared for surgery. In performing this test the leg is observed both anteriorly and posteriorly. Thus, the possibility of an incompetent lesser saphenous vein is explored.

With this test "blowouts" are easier to locate than with the comparative tourniquet test because the rapid filling of a vein is more obvious than its failure to empty. Moreover, many "blowouts" which would empty with the comparative tourniquet test will fill when the multiple tourniquet technic is followed.

Pratt[15] remarks that the comparative tourniquet test is difficult to perform and to interpret and is so time-consuming that it is not useful in the clinic. We believe that all two tourniquet tests are also time consuming and lack the degree of accuracy we have obtained with the multiple tourniquet technic. We frequently locate several "blowouts" in the same extremity. Of 102 high and low ligations there were seventeen with two and four with three or more ligations on the same extremity.

Ochsner[12] advises, when incompetent communicating veins are found with his comparative tourniquet test, that the saphenous vein be ligated at knee level. He admits that such ligations "do not preclude the possibility of recurrences through collateral channels around the lowest transection and ligation." We believe that recurrences can be avoided by ligating all "blowouts" at their site. The finding of only 3.4 per cent recurrence where this procedure has been followed is proof of its value.

The multiple tourniquet test is not only accurate but simple to perform. Rarely is it necessary to repeat it more than once. It is time-saving because not only is the Trendelenburg reaction indicated but also, in double positive cases, the "blowout" is accurately located. Therefore, it readily lends itself to use in a busy clinic.

Table 1
TYPES OF SAPHENOUS VEIN LIGATIONS

Total Ligations	High Ligations	High and Low Ligations	High and Lesser Saphenous Ligations	Low Ligations	Lesser Saphenous Ligations
200	60	102	13	20	5
Per cent	30	51	6.5	10	2.5

EVALUATION OF 200 LIGATIONS

Two hundred consecutive ligations on 140 patients, all tested with the multiple tourniquet technic, were selected for analysis.

Table 1 shows the distribution of the various ligations. It is significant that in this series 57.5 per cent of all operations were combined high and low or high and lesser saphenous vein ligations. In a report made by the author in 1940[18] on a series of 100 vein resections, I had only 21 per cent of multiple ligations. In this earlier series when only the classical Trendelenburg test and the comparative tourniquet test were used, 64 per cent of all operations were high saphenous resections only.

Table 11 indicates the value of the multiple tourniquet test in locating "blowouts." By comparison with the previous series it will be noted that both the positive and negative Trendelenburg tests were almost twice as frequent in the former series whereas in the present series the Trendelenburg double positive occurred two and one

half times as often as in the earlier group of cases. Our findings, therefore, are quite the opposite of Heyerdale and Anderson who claim that incompetent communicating veins are relatively uncommon. Since the same group of surgeons were responsible for both series of cases referred to above and since the only difference in diagnostic technic is the use of the multiple tourniquet test on patients in the present series, it seems obvious that this test is largely responsible for such a significant increase in the incidence of Trendelenburg double positive cases.

TABLE II
VALUE OF MULTIPLE TOURNIQUET TEST IN LOCATING INCOMPETENT COMMUNICATING VEINS

	Trendelenburg Tests		
	Positive (per cent)	Double (per cent)	Negative (per cent)
Series of 100 cases using classical Trendelenburg test	58	21	21
Present series 200 cases using multiple tourniquet test	30	57.5	12.5

FREQUENCY OF RECURRENCE OF VARICOSITIES

When the ligation and injection method of treatment has been employed for varicose veins the frequency of recurrence has been variously estimated at from 10 to 25 per cent within one year in even the most favorably treated patients, according to Dean and Dulin.[3] Sarma[17] reported recurrences up to 1930 of 16 per cent but by adopting additional ligation in the lower part of the thigh whenever indicated, the number of failures dropped to between 6 and 7 per cent.

Table III gives the per cent of recurrence following the various types of ligations. The overall recurrence rate of 5.5 per cent cuts in half the 11 per cent for the series reported by the author in 1940.[18] In this previous group of patients there was a recurrence rate of 16.7 per cent where high ligations alone were done. To me this means that previously we were missing "blowouts" in one out of every six patients. The low incidence of 3.4 per cent recurrence where multiple ligations were performed speaks well, I believe, for the value of the multiple tourniquet test as a real diagnostic aid. This is especially so when it is recalled that the Trendelenburg double case has been so prone to develop new "blowouts" after surgery.

TABLE III
FREQUENCY OF RECURRENCE OF VARICOSITIES

	Following all Ligations	Following High Ligations	Following High and Low Ligations Including Those in Which Lesser Saphenous was also Ligated	Following Low Ligations	Following Lesser Saphenous Ligations
No. of operations	200	60	115	20	5
Recurrences	11	4	4	2	1
Per cent of recurrences	5.5	6.6	3.4	10	20

Of the twenty low ligations reported, all but five were recurrences following high ligations not included in this series. Most of the high ligations had been done elsewhere. The five low ligations were undertaken with the realization that recurrences were likely. But either because the varicosities were mild or because of concurrent diabetes or cardiac disease the lesser surgical procedures was elected. The two recurrences reported were in this small group of five patients. Mahoner and Ochsner[11] remark that low ligation in many cases gives the best immediate results. But they warn that one must interrupt the saphenous vein above its tributaries if recurrence is to be avoided.

The lesser saphenous vein was encountered in 7 per cent of Larson and Smith's[8] series of 491 cases. White and associates[19] using a two tourniquet test, found 13 per cent of lesser saphenous veins involved in 214 patients. By our multiple tourniquet test we found only 2.5 per cent of the lesser saphenous veins alone involved. By including those patients in whom the lesser saphenous vein was incompetent in the presence of an incompetent greater saphenous vein, the incidence rose to 9 per cent. We thoroughly agree with Larson and Smith when they report that the importance of the lesser saphenous as a factor of venous stasis has been underemphasized. We cannot agree with them in their belief that ligation of the lesser saphenous vein will make ligation of "blowouts" unnecessary. The data presented in this report should sufficiently emphasize the value of ligating all "blowouts" encountered.

TABLE IV
AGE INCIDENCE

Age in Years	Men	Women	Total	Per Cent of Total
0–20	0	1	1	0.7
21–30	2	5	7	5.1
31–40	7	19	26	18.7
41–50	11	17	28	20.
51–60	20	28	48	34.5
61–70	6	12	18	12.9
71–80	3	3	6	4.3
Over 80	5	0	5	3.6

Table IV gives the age incidence in this series. Our findings of 73.2 per cent of patients between the ages of thirty and sixty years parallels the 75 per cent incidence for the same age group as reported by Hawkes and Hewson[4] for 600 subjects. Their ratio of women to men was three to one. Ours was eight to five. Our youngest patient was a girl of sixteen years and the oldest a man more than eighty-three years old. We did vein ligations on eight people over seventy, five of whom were eighty or more years old. Results in these patients were excellent. None of them has had a recurrence. They are all much more comfortable. We believe that age in itself is not a contraindication to vein surgery. We see no reason to deny the relief afforded by such surgery to the older age group.

RETROGRADE INJECTIONS ABANDONED

Since the technic of the high saphenous ligation operation is now quite well standardized, it seems superfluous to repeat it here. However, retrograde injection of sclerosing solution at the time of operation, advocated by the Mayo clinic group,[1] has been widely accepted as an essential part of the operative technic. We used it routinely until 1939 when we abandoned it except in a few individuals where large varicosities are present in the upper thigh. In our opinion, it is a procedure fraught with definite danger and many disadvantages. Homans[7] has warned of the danger of thrombosis and embolism following retrograde injections, particularly low in the saphenous system. Atlas[2] reports five patients with deep thrombosis following retrograde injections. Two patients died of pulmonary embolism. Aside from these real dangers there are many disadvantages, chief of which are: (1) the chemical phlebitis produced causes the patient to go to bed, thus defeating the ambulatory nature of the operation; (2) it is ineffective unless large amounts of sclerosing solution are used; (3) if several weeks are allowed for the veins to collapse, less solution will be needed for sclerosis. Harkins and Schug[5] and others have stressed similar reasons for abandonment of retrograde injections. We believe that the ambulatory feature of vein ligations is so important that anything that interferes with it, including retrograde injections, should be sacrificed to keep the patient on his feet. Since we ceased using retrograde injections we have been able to get our patients back to work within forty-eight to seventy-two hours. This is an economic advantage so important to many patients that they do not mind a few additional visits for sclerosing injections.

LOW LIGATION TECHNIC

Although the literature and text books adequately cover the technic of high saphenous vein ligation, little is said regarding low ligation. It is true that they are simple operations. However, because the vein is directly under the skin, care must be exercised not to nick the vein. The incision should be into but not through the skin. The final opening is made by spreading the skin apart with a small hemostat. The use of Allis clamps on the skin is to be condemned because the trauma thus produced causes the area to become devitalized and frequently causes slough. Traction sutures of nylon are recommended for retraction. The vein must be dissected one-half inch each way from the incisional margin. We have experienced delayed healing and stitch infection in low ligation wounds due to the use of catgut, silk and nylon. We have had the least reaction when we used No. 30 cotton for ties. Closure with a subcuticular suture of No. 00 nylon leaves a fine scar hardly visible after six months.

FOLLOW-UP

Adequate sclerosis of any varicosities remaining after ligation is essential to complete treatment. The patient should be observed three, six and twelve months after the last course of injections. Quite frequently, a few small varices will be found which were not present during the course of intensive treatment. Unless they are also sclerosed, they may be the site of subsequent "blowouts."

In our experience sodium morrhuate has been the best sclerosing agent. Soricin is nearly as good and is used whenever a patient exhibits a sensitivity to sodium morrhuate. We have found that up to 4 cc. of sclerosing solution is a safe amount to inject at one time if spread over two or more segments of the vein. By applying an elastic bandage to the leg for the first twenty-four hours after injections are given, we find that less solution is needed and disfiguring knots in the leg are avoided.

Linton advocates vein stripping rather than individual ligation of incompetent communicating veins. I believe that vein stripping is an unnecessary procedure in all but the exceptional case. If the incompetent perforators are properly ligated, the reverse flow of blood will be prevented. Vein stripping cannot do any more than this. But it is a much more formidable operation which carries with it a definitely high morbidity. Even when three or four "blowouts" must be ligated the patient remains ambulatory. He is definitely a bed patient following vein stripping. Above all, we cannot see why the rather formidable operation of vein stripping should be done routinely when we are able to effect 96.6 per cent cures with the less formidable high and low ligation technic which permits our patients to return to work in two or three days.

SUMMARY

1. A new diagnostic test, called the multiple tourniquet test is presented to locate accurately incompetent perforator veins in the thigh and leg in Trendelenburg double positive cases.

2. With this test both the regular Trendelenburg determination and the location of "blowouts" are simultaneously accomplished. Because the test is simple and quickly performed it lends itself to clinic use.

3. Two hundred consecutive ligations on 140 patients were analysed to demonstrate the value of this test. It is a significant fact that 57.5 per cent of all operations were combined high and low or high and lesser saphenous vein ligations as compared with only 21 per cent of multiple ligations in a previous series where this test was not used.

4. The recurrence rate of 3.4 per cent for multiple ligations was contrasted with a national average of from 10 to 25 per cent.

5. The importance of the lesser saphenous vein as a factor of venous stasis was emphasized and an incidence of 9 per cent reported.

6. Reasons why the author abandoned retrograde injection were discussed and

the danger of deep thrombosis and embolism stressed.

7. The author's technic for low ligations was described.

8. The importance of an adequate follow-up of all treated patients was emphasized.

9. Reasons why the author considers vein stripping operations unnecessary when incompetent perforators are encountered were presented.

REFERENCES

1. Allen, E. F., Barker, N. W. and Hines, S. A. Peripheral Vascular Diseases. Pp. 830–831. Philadelphia, 1946. W. B. Saunders Co.
2. Atlas, L. N. Hazards connected with the treatment of varicose veins. *Surg., Gynec. & Obst.*, 77: 136–140, 1943.
3. Dean, G. O. and Dulin, J. W. Treatment of varicose veins. *Arch. Surg.*, 39: 711–719, 1939.
4. Hawkes, S. Z. and Hewson, G. F. Study of varicose veins. *Surgery*, 7: 714–723, 1940.
5. Harkins, H. N. and Schug, R. Surgical management of varicose veins: importance of individualization in the choice of procedure. *Surgery*, 11: 402–421, 1942.
6. Heyerdale, W. W. and Anderson, E. M. Diagnosis and occurrence of communicating veins in the treatment of varicose veins. *Proc. Staff Meet., Mayo Clin.*, 17: 221–222, 1942.
7. Homans, J. Medical progress; diseases of veins. *New England J. Med.*, 231: 51–60, 1944.
8. Larson, R. A. and Smith, F. L. Varicose veins: evaluation of observations in 491 cases. *Proc. Staff Meet., Mayo Clin.*, 18: 400–403, 1943.
9. Luke, J. C. Venous circulation in the varicose extremity and its practical significance. *Surg., Gynec. & Obst.*, 70: 826–833, 1940.
10. Lyall, David. Treatment of varicose veins. *Surg., Gynec. & Obst.*, 82: 332–341, 1946.
11. Mahorner, H. R. and Ochsner, A. New test for evaluating circulation in the venous system of the lower extremity. *Arch. Surg.*, 33: 479–492, 1936.
12. Mahorner, H. R. and Ochsner, A. Modern treatment of varicose veins as indicated by the comparative tourniquet test. *Ann. Surg.*, 107: 927–951, 1938.
13. McCutchen, G. T. Varicosities of the lower extremity; description of an improved method of testing for incompetent communicating veins. *Am. J. Surg.*, 72: 63–65, 1946.
14. Pratt, G. H. Surgical treatment of varicose veins and ulcers by segmental sclerosis. *Am. J. Surg.*, 44: 31–38, 1939.
15. Pratt, G. H. Test for incompetent communicating branches in the surgical treatment of varicose veins. *J. A. M. A.*, 117: 100–101, 1941.
16. Sarma, P. J. Recurrences and failures following the modern treatment of varicose veins. *Surgery*, 10: 752–756, 1941.
17. Sarma, P. J. Treatment of varicosity of lower extremity. *South. Surgeon*, 11: 514–524, 1942.
18. Slevin, J. G. Varicose veins: surgical treatment of 100 cases analyzed. *J. Michigan M. Soc.*, 39: 932–936, 1940.
19. White, A. S., Haberer, J. J. and Gendel, S. The management of varicose veins in Army personnel. *Am. J. Surg.*, 63: 28–33, 1944.

TREATMENT OF VARICOSE ULCER

WILLIAM M. COOPER, M.D.

Director, Department of Peripheral Vascular Diseases and Adjunct Professor of Surgery,
New York Polyclinic Medical School and Hospital.

New York, New York

OF the many complications associated with varicose veins, ulcerations are the most important because of their frequent occurrence and the disability and suffering which they cause.

There is no standardized treatment for varicose ulcer. The numerous medicaments offered is evidence of the lack of knowledge regarding the basic problems involved. The rational treatment of ulcers should be based upon a sound understanding of the physiologic and mechanical factors responsible for movement of the blood through normal veins of the lower limbs, the abnormal factors present in the varicose state, the importance of other complicating conditions associated with varicose veins and ulcers and, above all, upon careful clinical observation and experience.

The author has employed over a period of years, practically every known medicament in the treatment of various types of ulcer cruris. In some patients the results were poor for two reasons: (1) Lack of appreciation of the basic problems involved, such as venous insufficiency, stasis and edema and (2) lack of specificity of the medicaments or ointments employed. Of great importance also in some cases is the presence of unrecognized epidermophytosis which is often present either as an etiologic factor or as a complicating factor.

PATHOGENESIS OF VARICOSE ULCER

Varicose ulcer, as the name implies, is associated with and due to varicose veins. In most instances the ulcer is located in the region of the medial malleolus, the most distal point of the great saphenous system. It is in this region that the hydrostatic pressure and stagnation of fluid in the tissues is most marked when the great saphenous vein is varicosed. Furthermore, this stagnant blood is oxygen-poor and metabolite-rich when compared with blood removed from normal veins in the lower limb. In addition, the exposed ankle is prone to minor traumas which frequently initiate the ulcer. Finally, it must be borne in mind that superficial thrombophlebitis is of common occurrence in patients with long standing varicose veins and the additional local phlebitis and lymphedema thus imposed upon an area of chronic stasis frequently act as the exciting factors in the production of ulcer.

The chronicity and intractability of some varicose ulcers is due to a number of changes in the tissues which may be briefly summarized: Once an ulcer starts, it always becomes infected. As a result, cellular infiltration takes place in the region of the ulcer margins and in the base or floor of the ulcer. Subsequently, fibrosis and cicatrical contraction of the tissues occur and the local capillary and arteriolar blood supply essential to growth of tissue and healing are shut off from the ulcer area. In addition, the usual pathologic changes, fibrosis and narrowing of the smaller surrounding blood and lymph vessels ensue with further embarrassment to the local tissue nutrition. Any type of treatment to be successful must be based upon a thorough knowledge of the underlying physiopathologic changes.

Some workers are opposed to injection therapy of varicose veins in the presence of ulcers and they usually defer such treatment until the ulcer is clean or has healed completely. When large varicose veins with demonstrable reverse flow are present, it has been the author's practice to operate (high ligation and division of the

great saphenous vein) early rather than late, regardless of whatever other local therapy is carried out. This operation frequently shortens the period of pain and disability to a great extent.

When dermatitis and enzema due to congestion of the skin in the presence of varices are present, bed rest for a short period of time, elevation and the application of Domeboro wet dressings 1:20 usually clear up the condition quickly. Domeboro tablets offer a convenient and excellent method of preparing Burow's solution. One crushed tablet dissolved in 1 pint of water makes a stable, buffered and non-irritating Burow's solution of 1:20 strength. Generally, the use of oiled silk or any other impervious material over the wet dressing should be avoided. Nothing in medicine has equalled the effectiveness of the Domeboro wet dressings in these patients with dermatitis and eczema. The comfort obtained almost immediately by their routine use is sometimes astonishing.

When considerable infection or epidermophytosis are present as complicating factors, wet dressings of potassium permanganate 1:5000 applied for a few days at the beginning of treatment may prove effective in preparing the area for subsequent Daxalan and Dome boot therapy.*

CHEMISTRY AND PHARMACOLOGY OF CRUDE COAL TAR

Coal tar (Pix lithanthracis) is a chemical storehouse of medicinal treasures. Investigation has proven that coal tar exhibits astringent, antiseptic and antiparasitic properties. In addition, it also exerts antipruritic, vasoconstrictive and keratoplastic effects as well as a definitely beneficial action on underlying cellular changes in various skin diseases. Many important therapeutic discoveries of recent decades have resulted from the numerous investigations in the chemistry and pharmacology of this black-appearing substance. It is therefore one of the most valuable remedies employed in dermatology.

Brocq,[2] a European dermatologist, first advocated the use of crude coal tar in the treatment of mosit varicose ulcers. White[1] is credited with the introduction of the use of coal tar in this country and his published studies are most illuminating. As crude coal tar became more popular, it was pointed out that coal tar varied greatly in composition and consequently in pharmacologic action. These physical and chemical differences of coal tars derived from various sources were emphasized by different investigators.

Research has proven that for the manufacture of a suitable coal tar product, the source of crude coal tar should always be the same. It should contain a minimum of naphthalene and other objectionable substances and a sufficient amount of anthracene oil, heavy oil and pitch to exert keratoplastic, keratolytic, antiseptic, astringent and antipruritic action. The antiseptic and antipruritic effects depend chiefly on naphthalene, phenols and cresols. The keratoplastic effect is dependent on the presence of methylnaphthalene, dinaphthalene, xylenol and naphthol. The reducing action is closely related to its keratoplastic effect. The ability of coal tar to penetrate the epidermis depends on the presence of distillation products with high boiling points, especially methylnaphthalene. It abstracts oxygen from the skin, thereby inhibiting mitosis and resulting in a numerical and dimensional decrease in the cells of the rete malpighian and corneous layers.

The introduction of synthetic tars, distillates, so-called distillates, filtrates, and the solution of coal tar in fatty and nonfatty bases as a substitute for the whole crude coal tar product, have not been satisfactory. Therefore, the search for a satisfactory crude coal tar product to use in our clinic was instituted. Our attention was soon focused on a rigidly standardized, uniformly colored, aged crude coal tar product, called Daxalan,* used by dermatologists.

*The Daxalan ointment and the Dome boots employed in this study were furnished through the courtesy of Dome Chemicals, Inc., New York, N. Y.

Daxalan was first reported in the literature by Combes[3] in 1943, and again in 1944.[4] These observations have since been confirmed by other eminent authorities. With this background in mind, Daxalan was first employed clinically for all types of ulcer cruris in the Department of Peripheral Vascular Diseases at the New York Polyclinic Hospital.

Daxalan has the following formula:

Crude coal tar	2.88
Zinc oxide	5.37
Starch	53.75
Petrolatum, Q. S. ad	100.00

It is made by a special process and is aged for six months. This results in a smooth, homogenous ointment, uniformly dark in color, with no trace of coal tar flecks or small, black particles.

It is advisable to know that occasional reactions may be encountered when employing daxalan. Combes[3] has described the reactions and the precautions to be observed which are worthy of repetition here: (1) Avoid exposure to direct sunlight of the area to which tar is applied or has recently been applied. Tar is a photosensitizer, owing to the presence of acridine and the anthracene oils; (2) avoid prolonged use of tar on hairy areas. Folliculitis may occur, owing to pitch and paraffin oils; (3) avoid changing the dressing often; (4) do not apply tar to infected or impetiginized lesions; (5) do not apply tar to more than one-quarter of the body surface at one time. There is danger of absorption, since coal tars contain from 2 per cent to 4 per cent phenol; (6) be on the lookout for sensitivity after prolonged use; and (7) keep coal tar and coal tar pastes in carefully sealed containers to avoid evaporation of volatile ingredients which constitute a valuable part of their efficiency.

As soon as the skin clears and edema is reduced, ambulatory treatment is instituted. In many cases, the treatment is started without much preliminary cleansing or treatment other than the removal of the scaling skin by means of mineral oil or Domolene ointment (vaseline with a wetting agent). No benzene or ether is employed for cleansing since they are irritating and dry the area too greatly.

TREATMENT BY DAXALAN OINTMENT AND DOME PASTE BOOT

The objectives of this treatment are (1) to combat local infection and to stimulate healing; (2) to overcome the venous insufficiency stasis and edema present in most of the patients encountered in practice.

The first objective is attained by the daxalan ointment and the second by the principle of compression so effectively accomplished by the application of the Dome boot, a modified Unna's paste boot.

When the skin has been cleansed, a thick application of daxalan ointment is made directly to the ulcer and the surrounding skin. Unscented talcum powder is then sprinkled on the surface of the ointment application and a smooth, evenly applied Dome boot is then placed on the limb from the toes to the knee in the following fashion: A circular turn is made around the foot and carried up to the ankle and heel, where several figure eight turns are necessary to cover the heel. At no time is the bandage given any reverse turns because, when the boot stiffens, this may press against the skin as a ridge and cause much discomfort. The bandage is cut after one and one-half turns as it ascends the leg, each turn covering one-half of the preceding turn. The bandage or boot is thus completed an inch or two below the knee. The bandage, if properly applied, should cover the average leg approximately three times. The bandage (boot) is allowed to harden or dry in the air and the patient is instructed to return in one week. If the atmosphere is humid, the boot may be covered with a roller gauze bandage after a short while to protect the patient's clothing. (Figs. 1 to 5.)

The patient is usually ambulant after the boot application and is encouraged to remain so as far as possible. After one week, the boot is cut, the ulcer and surrounding skin cleansed with mineral oil or Domolene and a second application of daxalan ointment, talcum powder and Dome boot is

made. If the patient is comfortable, the second boot may be worn for a period of two weeks. The same routine is repeated until the ulcer is firmly healed. Occasionally, a yellowish or brownish stain will appear on the surface of the boot in the region of the ulcer. This may be covered with a little gauze which can be changed whenever desired.

During the course of treatment described above it will be noticed that when the boots are being changed the new skin appears

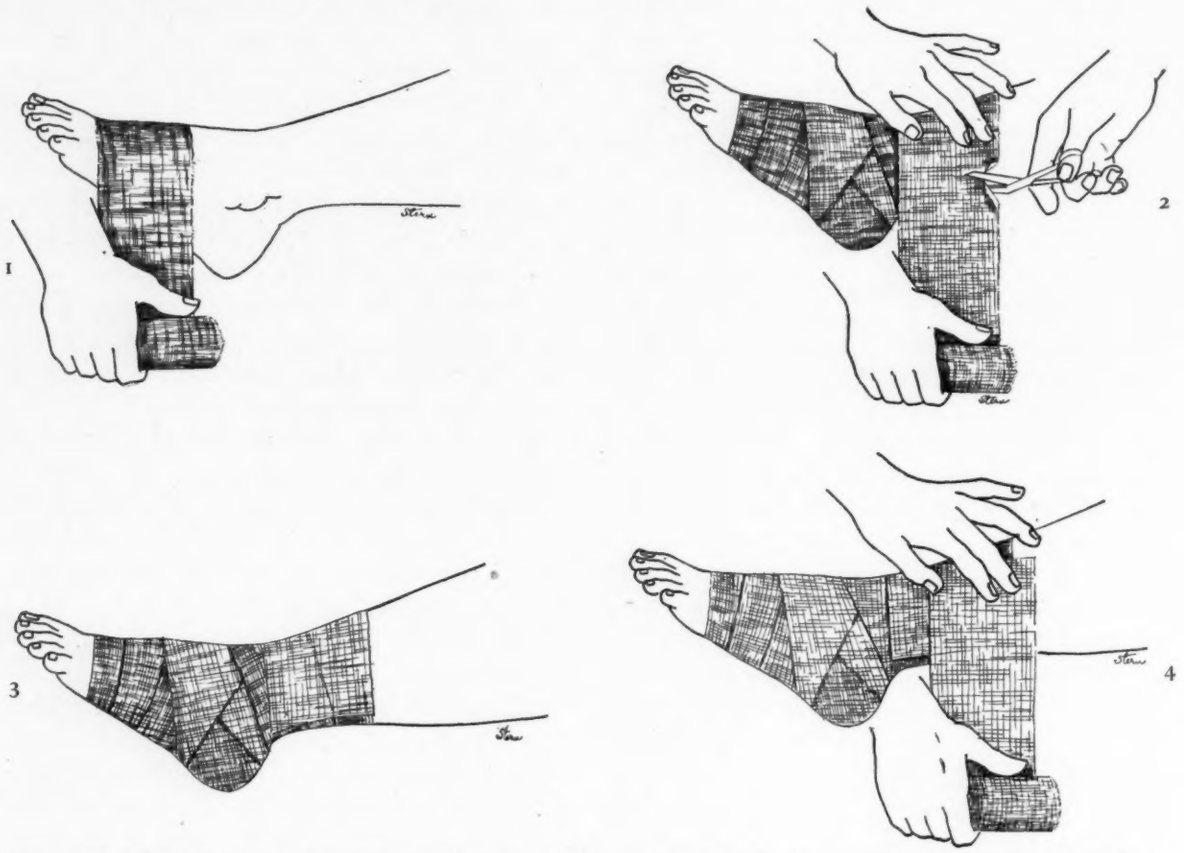


Fig. 1. The Dome Boot (bandage) is started with one horizontal turn applied around the foot and, when completed, the bandage is directed obliquely over the heel, etc.

Fig. 2. After the heel has been adequately covered the same method of application, i. e., one horizontal turn of the bandage followed by an oblique half turn and cut is carried out. This insures a flat application of the bandage to the skin surface.

Fig. 3. The bandage after it has been cut as described under Figure 2.

Fig. 4. The bandage is continued as described in text with a horizontal turn encircling the limb and a one-half oblique turn, after which the bandage is again cut and the same technic is carried out until the calf is covered.

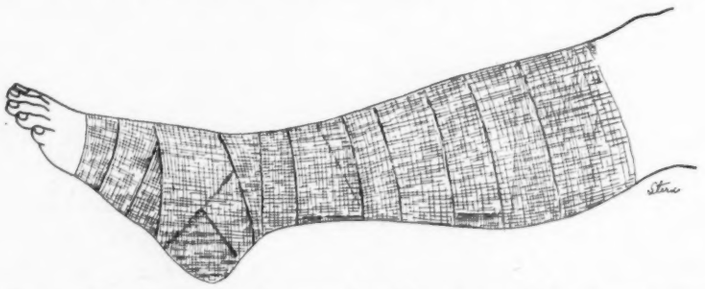


Fig. 5. This illustrates the completed bandage which always must cover the leg to a point well above the calf, otherwise the bandage may slip toward the ankle.

FIG. 6. Case No. 588-46, January 31, 1946. F. L., aged thirty-six, a married female with six children, was admitted to the New York Polyclinic Hospktal out patient department on January 22, 1946 with a history of chronic, recurring ulcers of the left leg and an episode of post partum thrombophlebitis antedating the appearance of the ulcers. The history was otherwise irrelevant with the exception of a probable background of faulty nutrition since the patient was extremely poor and was obliged to do domestic work to supplement the family income. Examination disclosed multiple ulcers of the medial aspect of the left leg with considerable dermatitis and eczema. Edema 2 plus. The blood Wassermann test was negative. Treatment for the first fieek consisted of bed rest, elevation and Domeboro (1:20) wet dressings. On January 31, 1946 Daxalian ointment and the Dome boot were applied in the manner already described. The patient returned in one week, the boot was removed, the skin was cleansed with Domolene and a second treatment of the same type was given. In addition, Protinex (defatted, wheat germ embryo containing 37 per cent amino acids and vitamin B complex) and ascorbic acid three times a day after eating were prescribed.

FIG. 7. Same case as in Figure 6. February 14, 1946. Two weeks after commencing treatment there was complete healing of the ulcers noted in Figure 1. Only two applications of the Daxalan ointment and the Dome boot had been made in this case. Note the firm, white skin covering the previously ulcerated areas.

very firm and white. This should not be disturbed by too vigorous cleansing each time, but rather by gentle massage with the Domolene or mineral oil, in order to remove the old ointment before making a new application. After the ulcer has healed, particularly in the case of larger ulcer with edema, the treatment may be continued for several weeks to allow the new skin to become very firm.

At this time also, the surgeon will take cognizance of the underlying conditions responsible for the ulcer and direct his treatment with the idea of eliminating, as far as possible, the fundamental etiologic factors. During treatment with daxalan ointment and the Dome boot these conditions are adequately controlled; the daxalan ointment by stimulating rapid epithelization and overcoming infection and the Dome boot by correcting the underlying stasis and edema by the principle of compression. It is advisable to point out that the optimum time to apply the treatment is during the morning hours before the patient's limb has had a chance to become edematous.

Figures 6 to 15 illustrate several types of leg ulcers, all of which were treated by the method described. The results obtained in

Fig. 8. Same case as in Figure 6. March 14, 1947. Follow-up photograph four weeks after healing and completion of treatment; six weeks after commencing treatment. Note the firm-textured skin.

9

10

Fig. 9. Case No. 7322-44. February 7, 1946. M. D., aged forty-three, a colored female, married with two children, was admitted to the New York Polyclinic Hospital out patient department on September 21, 1944. The only noteworthy incident in this patient's past history was a spontaneous cerebral hemorrhage with resultant right hemiplegia at the age of thirty. She had been under treatment in the medical clinic for this condition as well as hypertension. The blood Wassermann was negative. Various ointment applications were made without any appreciable improvement. Two weeks prior to the time this photograph was taken Domeboro wet dressings (1:20) were applied and some healing is noted around the periphery of the ulcer. In addition the granulations appeared much cleaner. On February 7, 1946, the date of this photograph, the Daxalan ointment-Dome boot treatment was started and the dressings were changed weekly. Protinex and ascorbic acid were given three times a day after eating.

Fig. 10. Same case as in Figure 9. March 21, 1946. Six weeks after beginning the Daxalan ointment-Dome boot treatment there was complete, firm healing of the ulcer of the lateral aspect of the left leg.

11

12

FIG. 11. Case No. 10965-40. January 31, 1946. Medial surface of the left leg at commencement of treatment. This figure and Figures 12, 13, 14 and 15 illustrate, in an elderly female, the rather remarkable progress and healing of multiple ulcers of the right leg of more than fifteen years' duration. S. M., seventy-five years of age and a self-supporting janitress, had been a patient in various departments of the New York Polyclinic Hospital. She was admitted to the vascular clinic on August 29, 1940 with a history of chronic, recurring ulcers of the right leg for the past fifteen years. Various types of medicaments were applied, including most of the ointments advocated for the treatment of these conditions, but with no appreciable improvement.

On January 31, 1946 the Daxalan ointment-Dome boot treatment was started and the ointment and boot changed once weekly thereafter. This was supplemented with Protinex and ascorbic acid three times daily. Healing of the ulcers of the lateral surface was noted on March 14, 1946, and of the large ulcer on the medial surface, April 11, 1946.

FIG. 12. Same case as in Figure 11. January 31, 1946. Lateral surface of the right leg at onset of treatment.

13

14

Fig. 13. Same case as in Figure 11. March 14, 1946. Medial surface of the right leg six weeks after starting treatment showing considerable epithelization from the ulcer margins toward the center of the ulcer. Note the healthy, red granulations in the unhealed central portion.

Fig. 14. Same case as in Figure 11. March 14, 1946, six weeks after the treatment was instituted, showing complete healing of the ulcers of the lateral surface of the right leg.

each patient as well as complementary treatment are described in the text accompanying the photographs.

SUMMARY AND CONCLUSIONS

One-hundred forty-seven subjects with chronic leg ulcers of varying etiologic backgrounds were treated by the daxalan-Dome boot technic over a period of eighteen months. Most of the patients were of the type usually described as "varicose," but a large proportion of the patients presented edema due to thrombophlebitis or chronic venous insufficiency associated with extensive varicose veins of long standing.

The maximum period of time required to effect a cure of any individual in this series was ten weeks and the minimum, two weeks.

Dermatitis if present, was always treated by simple, nonirritating, local therapy consisting of Domeboro ($\frac{1}{20}$) wet dressings. These proved vastly superior to any other

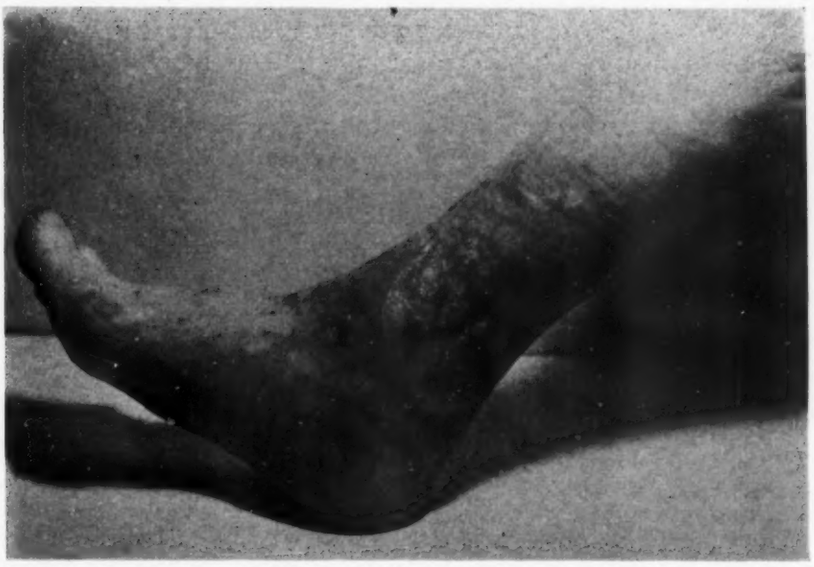


FIG. 15. Same case as Figure 11. April 11, 1946, ten weeks after commencing treatment with Daxalan ointment and Dome boot, showing complete healing of the large ulcer of the medial surface of the right leg. Treatment throughout was on an ambulatory basis and this elderly patient was permitted to do her usual work as a janitress.

type of treatment. Subsequent treatment with daxalan and the Dome boot sufficed to cure the ulcer.

Sensitivity or allergy to daxalan was encountered in only two patients in this series and in both instances treatment with daxalan ointment was immediately discontinued. In this connection the author wishes to point out the importance of performing a patch test on each new patient, care being taken to do this test in an area of diseased skin. If no irritation results from the medication, one may employ daxalan with safety. Furthermore, if one so desires, the half-strength daxalan, known as daxalan-pediatric, may be employed at first and if no irritation is observed, later treatments may be carried out with regular daxalan. The precautions mentioned by Combes should be observed whenever daxalan is employed for a long period of time.

While other satisfactory methods of treatment for the cure of leg ulcers have been utilized by the author, the daxalan-Dome boot method has proven wholly satisfactory as an ambulatory method of treatment for these distressing conditions. It permits many disabled and partially disabled individuals to engage in their usual work without discomfort.

The daxalan-Dome boot method of treatment conforms to sound physiologic principles; the ointment by its antiseptic, stimulating and epithelizing qualities and the boot, because of its semi-rigid character, by compressing the limb, eliminating edema and causing drainage from the ulcerated area to diminish. It seems almost needless to repeat that healing of a leg ulcer in an edematous limb is almost impossible unless the "water-logged" condition is eliminated. A smooth, properly applied boot accomplishes this nicely.

REFERENCES

1. WHITE, C. J. Crude coal tar in dermatology. *Arch. Dermat. & Syph.*, 4: 796–803, 1921. Treatment of eczema in childhood. *M. & S. J.*, 185: 5, 1915.
2. Quoted by White, C. J.[1]
3. COMBES, F. C. The use of coal tar in the treatment of skin diseases. *New England J. Med.*, 228: 384, 1943.
4. COMBES, F. C. Coal tar in medicine. *Indust. Med.*, 13: 550, 1944.
5. LEVIN, O. L. and BEHRMAN, H. T. A new, effective wet dressing. Clinical studies on 50 patients with common dermatoses. *Indust. Med.*, 10: 81, 1941.
6. FISHER, J. C. A new wet dressing. *Journal-Lancet*, 62: 101, 1942.

TREATMENT OF CARCINOMA OF THE BREAST*

DAVID W. ROBINSON, M.D.
Assistant in Surgery, The University of Kansas Hospitals, School of Medicine
Kansas City, Kansas

THE present study of 324 patients with carcinoma of the breast was made to determine (1) the clinical error of axillary node involvement proven histologically, (2) the effect of duration of symptoms on survival rate, (3) the relative merits of various types of treatment, (4) the comparison of the survival rate after radical and subradical surgery, (5) the survival rate according to the histological type of carcinoma, (6) the incidence and the effect on survivals of the site of the primary involvement, (7) the percentage of local recurrence in each clinical group and (8) the fate of patients who survived for five and ten years.

A few definitions are necessary to further outline the discussion. Patients have been classified in four main groups as follows: Group I, Carcinoma confined to the breast; Group II, metastases to the axillary nodes only; Group III, metastases beyond the axillary nodes; Group IV, hopeless cases.

The group designation was made only on histological proof from removed tissue, an important point which has been emphasized previously.[4,5,15] Three main pathological groups were used in this classification: (1) Scirrhous, fibrous stroma predominating; (2) medullary, epithelial elements predominating; (3) adeno or ductal, intraductal and intracystic origin or carcinoma with definite adenomatous structure. Paget's disease, mucoid and comedo carcinomas were relatively rare. This classification is useful, although probably not as accurate as one which stresses the origin of the tumor.[1,10]

The term five-year survival is used instead of "cure" since many who lived five years had carcinoma present at the end of the five-year period and many later developed recurrences and died after five years.

TABLE I
CLINICAL ERROR IN DIAGNOSIS OF AXILLARY NODES IN GROUPS I AND II

	No.		No.		
Clinically negative nodes.....	85	Pathologically positive nodes..	27	Per cent of error.....	31.8
Clinically positive nodes.....	136	Pathologically negative nodes..	36	.....	26.4
				Average error both groups...	28.5

Of the 324 cases studied, 24 or 7.4 per cent were not traceable up to the end of five years and 5 more were lost later, making a follow-up percentage of 91 per cent. Two hundred fifty-seven operations were performed by ten different surgeons. Seventy-five per cent of these operations were performed by Dr. T. G. Orr. There were ten incidental deaths (deaths due to other diseases) and five postoperative deaths. The operative mortality was 2.4 per cent. These fifteen deaths were excluded from most of the analyses.

A definite clinical error in the estimation of axillary node involvement is at once apparent from a study of Table I. Twenty-seven of eighty-five patients said to have non-palpable nodes had definite carcinoma in the nodes, making an error of 31.8 per cent. In 136 patients with nodes palpably enlarged and thought to have carcinoma, thirty-six were found not to have axillary involvement on section, an error of 26.4

* From the Department of Surgery, University of Kansas, Kansas City, Kan.

per cent. Clinical findings for determining the presence or absence of carcinoma in nodes were wrong in about one out of three patients. Other authors[11,14] have reported 31 per cent and 28 per cent of errors in the clinical appraisal of axillary nodes.

TABLE II
COMPARISON IN GROUPS I AND II OF DURATION OF SYMPTOMS IN MONTHS BEFORE ADMISSION TO AVERAGE AGE ON ADMISSION OF FIVE-YEAR SURVIVALS AND THE DEATHS

	Duration before Admission in 5-year Survivals, Mo.	Duration before Admission in Death Cases, Mo.	Average Age of 5-year Survivals on Admission, Yr.	Average Age of Death Cases on Admission, Yr.
Group I...	11.3	12.1	52.4	55.1
Group II...	9.9	12.3	52.7	50.3

Comparing five-year survivals in Groups I and II the duration of symptoms before admission showed no significant difference. (Table II.) The average ages of five-year survivals in Groups I and II were nearly identical but in the deaths the average age was five years younger in Group II than in Group I. This was as expected from the known fact that, as a rule, carcinoma in the younger age group metastasizes and kills more rapidly.

Radical surgery is certainly the only treatment which can be expected to effect many cures. Considering all groups together, a comparison of the five-year survival rate in patients with radical surgery alone, with radical surgery plus preoperative or postoperative irradiation, or both, shows nothing very significant. Radical mastectomy alone plus preoperative irradiation showed almost identical survival rates. (Table III.)

With postoperative irradiation the survival rate was increased by 5 per cent. With radical surgery followed by postoperative irradiation most authors have shown the same[5] or greater increase,[6,11,12] although some[1,4] reported poorer results. The increase with postoperative irradiation of survivals occurred in Group II but not in Group I. Undoubtedly cases wherein this treatment was used were initially more far advanced. The twenty-seven simple amputations performed were almost entirely done for palliation, yet over 18 per cent of these survived five years. Daland[2] in reporting one hundred untreated cases found twenty-two alive after five years and five still living after ten years.

TABLE III
COMPARISON OF FIVE-YEAR SURVIVALS ACCORDING TO THE METHOD OF TREATMENT USED*

	University of Kansas Hospitals			Operation Elsewhere		
	Total No.	No. 5-year Survivals	Per Cent of 5-year Survivals	Total No.	No. 5-year Survivals	Per Cent of 5-year Survivals
Radical mastectomy alone	48	21	43.7	11	7	63.7
Radical + preop. irradiation	39	17	43.6	1	0	0
Radical + postop. irradiation	72	35	48.6	13	5	38.5
Radical + pre and postop. irradiation	44	15	32.6	1	0	0
Simple mastectomy alone	9	2	22.2	6	1	16.7
Simple + preop. irradiation	5	2	40			
Simple + postop. irradiation	5	0	0	4	0	0
Simple + pre and postop. irradiation	8	1	12.5	1	0	0
Total	230	93	44.3			

* No incidental deaths, operative deaths or cases of doubt included.

In some patients the routine radical operation was modified by leaving intact one or both pectoral muscles. The effect on survival rate of this subradical amputation, consisting of completely removing all breast tissue and cleaning out the axillary contents, was studied by comparing the results with those after radical surgery in Groups I and II. (Table IV.) The selection of the subradical procedure was made for some patients who were aged or debilitated, who had a low grade malignancy such as malignant intracystic or intraductal papilloma with little invasion as proven by biopsy or who had concomitant disease of such severity as to modify the treatment. In Group I there were forty-four five-year survivals in sixty-three patients who had the radical operation, or 73 per cent, compared with seventeen five-year survivals in twenty patients who had the subradical amputation, or 85 per cent. In Group II eighteen of seventy-four patients, or 24.3 per cent, lived five years after radical operation as compared with four of sixteen, or 25 per cent, who underwent subradical surgery. It would seem that with proper patient selection the subradical operation is warranted and certainly produces less shock and a better functional result. Five-year survivals for Group I were 73.5 per cent, averaging both radical and subradical results as compared with 24.4 per cent for Group II. One patient in sixteen in Group III who submitted to radical operation, mainly for palliation, lived five years.

A study of the influence of the various histological types of carcinoma on the survival rate was made. Comparing average ages for the different histological types revealed nothing startling. Adeno, ductile, mucoid and comedo carcinoma occurred in the slightly older patients rather than scirrhous and medullary carcinoma. (Table V.) Of the three main types, scirrhous, medullary and adeno (ductile) carcinoma, the survival rate in the first two were practically identical but in adeno (ductile) carcinoma 7 per cent more patients lived five years. This was as expected. Mucoid and comedo carcinoma and Paget's disease were too few to be statistically significant but the relatively lower grade of their malignancy is known.

The primary site of the carcinoma in the breast reviewed to determine the incidence and the effect on the five-year survival rate with and without axillary involvement. (Table VI.) The upper outer quadrant was by far the most common primary site, occurring in 52.6 per cent of the total. Other primary sites were fairly equally distributed in the inner quadrants, the lower outer quadrant and beneath the nipple. It was interesting to find that the inner quadrants without axillary node involvement gave a fairly high percentage of

TABLE IV

COMPARISON OF FIVE-YEAR SURVIVALS BY GROUPS I AND II ACCORDING TO RADICAL OR SUBRADICAL OPERATION*

	Group I			Group II		
	No. Operations	5-year Survivals	Per Cent of 5-year Survivals	No. Operations	5-year Survivals	Per Cent of 5-year Survivals
Radical	63	44	69.9	74	18	24.3
Subradical	20	17	85	16	4	25
Total	83	61	73.5	90	22	24.4

* No case of operative deaths or incidental deaths are included.

TABLE V

COMPARISON OF HISTOLOGICAL TYPES BETWEEN INCIDENCE, AGE AND PERCENTAGE OF FIVE-YEAR SURVIVALS OF PATIENTS IN GROUPS I, II AND III*

Histologic Types	No.	Percentage Incidence	Average Age on Admission, Yrs.	Number of 5-year Survivals	Percentage of 5-year Survivals
Scirrhous	166	66.4	52.2	62	37.3
Medullary	16	6.4	50.7	6	37.5
Adeno (ductile)	56	22.4	58.6	25	44.6
Mucoid and comedo	6	2.4	57	4	66.7
Paget's disease	4	1.6	54.8	2	50

* Only patients who had cases that supplied definite pathological diagnoses are included here. Five-year survivals quoted are those on which all types of surgery were performed. Incidental and operative deaths are not excluded.

five-year survivals but a comparatively lower survival rate than the outer quadrants when the nodes contained cancer at the time of operation. Being further from the axilla, if nodal involvement is present in the inner quadrant group, metastases more likely have already taken place in vital organs. The importance of quadrant involvement has been noted previously.[7,9]

Most interesting was a follow-up study of the fate of the five and ten-year survivals. There were one hundred patients who had lived five years after treatment but ten were excluded since they died from causes other than carcinoma and six were not included as they had had their surgery performed elsewhere. Of the eighty-four remaining, twenty-five, or 29.8 per cent, have subsequently died from their original carcinoma and many of the eighty-four in the follow-up series are only one to three years past the five-year mark. Out of sixty-one patients in Group I five-year survivals 13, or 21.3 per cent, subsequently died of metastases. In Group II, 11 of 22 patients, or 50 per cent of the five-year survivals later died of the original carcinoma. Among twenty-two who had survived ten years,

TABLE VI

COMPARISON OF INCIDENCE AND FIVE-YEAR SURVIVALS ACCORDING TO LOCATION IN BREAST OF PATIENTS IN GROUPS I AND II*

Location	Total No.	Per Cent Incidence	No. in Group I	No. 5-year Survivals	Per Cent 5-year Survivals	No. in Group II	No. of 5-year Survivals	Per Cent 5-year Survivals
Upper outer quadrant.....	130	52.6	53	30	56.6	63	11	15.9
Lower outer quadrant.....	21	8.5	9	6	66.7	8	3	37.5
Upper inner quadrant.....	30	12.2	15	12	80	12	2	16.7
Lower inner quadrant.....	21	8.5	12	6	50	7	1	14.3
Beneath nipple.....	24	9.9	12	6	50	12	3	25
Total.....	226	....	101	60	59.4	102	20	19.6

* Only those patients are included in which the location was stated without question. All types of treatment are included.

The problem of local recurrence in its relation to the type of surgery employed has been presented in studies from many clinics. Radical amputation with plastic closure (Handley) is employed almost routinely in this clinic. Only a very few mastectomies in this series required skin grafting. The local recurrence rate in eighty-three patients in Group I was 13.3 per cent as compared with 20 per cent of ninety patients in Group II and 44 per cent of sixteen patients in Group III. The over-all local recurrence rate including the Group III patients was 20 per cent. (Table VII.)

TABLE VII

INCIDENCE OF LOCAL RECURRENCE AFTER RADICAL OPERATION BY ALL GROUPS*

Group	No. of Operations	No. with Local Recurrence	Per Cent of Local Recurrence
I	83	11	13.3
II	90	18	20
III	16	7	44
All groups	189	36	20

* Deaths due to operation, deaths not due to carcinoma and patients with unknown pathology of axillary nodes are not included.

Excluding Group III the local recurrence rate was 16.0 per cent averaging the results in Groups I and II. These results are more favorable than percentages reported from large clinics[4,8] solely employing the Halsted type operation which is said to lessen the number of local recurrences and are about the average, 19.4 per cent, of several authors[4,13,14,15,17] employing plastic closure.

nine have either succumbed or are living with their cancer at present. Two of the nine patients had a recurrence before the five-year mark, two between the five and ten-year periods and five developed metastases attributable to their original carcinoma after ten years apparent freedom from disease. Of Simmons[14] five-year survivals, 19 percent later developed recurrence.

SUMMARY

1. The clinical estimation of axillary involvement in carcinoma of the breast is in error in approximately one out of three patients.

2. The average duration of symptoms before admission is about the same in those patients with and without axillary metastases.

3. Radical surgery is the main therapeutic weapon to combat carcinoma of the breast. Postoperative irradiation will give a few more five-year survivals in Group II patients.

4. In properly selected patients, considering histology, age, condition and extent of the carcinoma, leaving one or both of the pectoral muscles does not lower the survival rate.

5. Scirrhous and medullary carcinoma are the most malignant, adeno is slightly less malignant and Paget's disease, mucoid and comedo carcinoma are the least malignant.

6. Carcinoma developing in inner quadrants of the breast has a better prognosis than those in the outer quadrants, unless the axillary nodes are involved in which case the reverse is true.

7. With radical surgery and plastic closure the local recurrence rate was 13.3 per cent in Group I, 20 per cent in Group II and 44 per cent in Group III. The average recurrence rate in Groups I and II was 16.0 per cent.

8. Nearly 30 per cent of the five-year survivals later died of carcinoma and nine of twenty-two ten-year survivals had at ten years or later showed a recurrence.

9. It is fully recognized that the study of such a small number of patients is not of great statistical value but presents the trend only in one clinic.

REFERENCES

1. Adair, F. The role of surgery and irradiation in cancer of the breast. *J. A. M. A.*, 121: 553, 1943.
2. Daland, E. M. Untreated cancer of the breast. *Surg., Gynec. & Obst.*, 44: 264, 1927.
3. Foote, F. W. and Stewart, F. W. Comparative studies of cancerous versus non-cancerous breasts. *Ann. Surg.*, 121: 6, 1945; 121: 197, 1945.
4. Haagensen, C. D. and Stout, A. P. Carcinoma of the breast; results of treatment. *Ann. Surg.*, 116: 801, 1942.
5. Harrington, S. W. Results of radical mastectomy in 5,026 cases of carcinoma of the breast; various clinical and pathological factors which influence prognosis. *Pennsylvania M. J.*, 43: 413, 1940.
6. Keynes, G. The place of radium in the treatment of carcinoma of the breast. *Ann. Surg.*, 106: 619, 1937.
7. Lee, B. J. End results in the treatment of cancer of the breast by radical surgery combined with preoperative and postoperative irradiation. *Am. J. Surg.*, 20: 405, 1933.
8. Lewis, D. and Rienhoff, W. F., Jr. A study of the results of operation for the cure of cancer of the breast. *Ann. Surg.*, 95: 336, 1932.
9. Marshall, S. F. and Higginbotham, J. Carcinoma of the breast—an analysis of 196 cases. *S. Clin. North America*, 18: 671, 1938.
10. MacCollam, W. G. Textbook of Pathology. Philadelphia, 1937. W. B. Saunders Co.
11. Pfahler, G. E. The treatment of carcinoma of the breast. *Am. J. Roentgenol.*, 39: 1, 1938.
12. Portmann, U. V. Irradiation in the treatment of cancer of the breast. *Cleveland Clin. Quart.*, 6: 109, 1939.
13. Rodman, J. S. Skin removal in radical breast amputation. *Ann. Surg.*, 118: 694, 1943.
14. Simmons, C. C. Cancer of the breast—ten year end results. *Surg., Gynec. & Obst.*, 74: 763, 1942.
15. Shore, B. R. Carcinoma of the breast. *Surg., Gynec. & Obst.*, 71: 515, 1940.
16. Warren, S. and Tompkins, V. N. The significance of the extent of axillary metastases in carcinoma of the female breast. *Surg., Gynec. & Obst.*, 76: 327, 1943.
17. White, W. C. The problem of local recurrence after radical mastectomy for carcinoma. *Surgery*, 19: 154, 1946.

TRAUMA TO THE REGION OF THE BURSA ANSERINA

LIEUT. COLONEL CHARLES J. SUTRO
Medical Corps, Army of the United States
Fort Riley, Kansas

FRACTURE of a single bone of the leg without any associated subluxation at the upper or lower fibulotibial articulation was the usual injury sustained by soldiers of horse cavalry or mule pack outfits. These fractures caused by kicks of the animals were usually of the comminuted stellate type and showed on radiographic examination very little displacement of the main fragments. (Fig. 1.) Healing of these fractures occurred without any complications and did not result in impairment of motion at the ipsilateral knee or ankle.

Direct impact of the animal's hoof may also cause, but less frequently, a thickening of the soft tissues in the region of the bursa anserina* without fracturing the underlying bone. Such swellings may be long lasting and may simulate intra- or extra-articular lesions especially that of cysts of the semilunar cartilages. We had an opportunity to study three soldiers with thickening of the soft tissues in the region of the bursa anserina.[1–3] In one of the three, surgical intervention was necessary in order to effect a cure.

In this investigation, the clinical, radiographic and histological findings and differential diagnoses are presented primarily to discuss the unusual condition of chronic thickening of the soft tissues in the region of the bursa anserina as caused by direct trauma to the local part.

FIG. 1. Radiograph shows comminuted fracture of the upper third of the tibia. This was caused by a kick of a mule.

HISTORY AND PHYSICAL FINDINGS

Each of the three soldiers in question stated that they were struck by the hoof of an animal while participating in military training. The kick caused a swelling on the medial aspect of the upper portion of the leg of each of the three soldiers. The three patients sought admission to the hospital from nine, thirty and forty-four days, respectively, after the injury because of persistent local pain and swelling. In the case of the patient who was examined nine days after the injury, we found a definite prominence along the inner aspect of the proximal portion of the right leg in the region of the bursa anserina. When the affected leg was fully flexed against active resistance the patient experienced severe pain over this swelling. There were five

* The bursa anserina is situated superficially to the tibial collateral ligament on the upper medial surface of the tibia. The bursa is enclosed by the tendons of the sartorius, gracilis and semitendinosus.

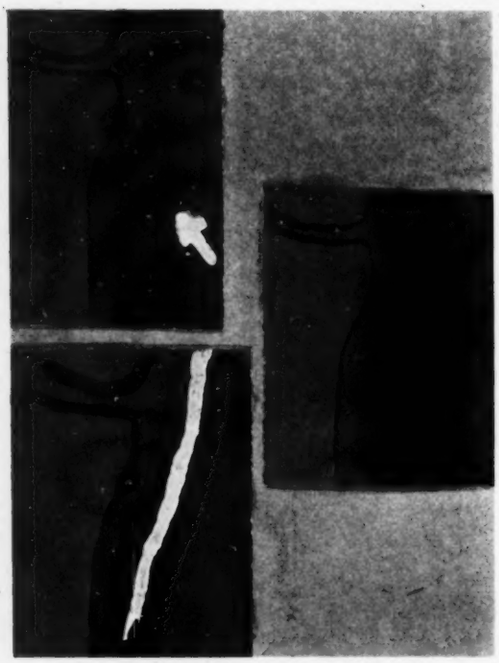


Fig. 2. Radiographs (retouched) made in the anteroposterior and oblique projections show thickened soft tissues in the region of the bursa anserina (arrow). The three views are of the same knee.

degrees of restriction to active and passive extension of the affected leg. Tenderness was present along the course of the internal lateral ligament, as well as in the regions of the anterior and posterior horns of the internal semilunar cartilage.

As for the examination of the patient who was seen thirty days after the injury, a flat mass measuring the diameter of a silver dollar was noted on the upper medial aspect of the leg; it extended to the level of the upper articular surface of the tibia. This mass was firm, round, tender to the touch and freely moveable. Active flexion of the leg against resistance caused pain over the described swelling. The range of active and passive flexion and extension of the leg was within normal limits. As for the examination of the patient seen forty-four days after the injury we also observed a mass, the size of a small lemon, situated on the medial aspect of the upper portion of the leg and knee. This swelling was tender to the touch and did not interfere with the range of active and passive movements of the left leg. There was no effusion in the knee joint. Active flexion of the leg against resistance, however, produced local discomfort over the swelling. No instability was noted of the bones comprising the knee joints of this or of the other two patients in question. Similarly, there was no evidence of enlargement of any other bursae about the knee of these three patients.

Radiographic examinations were made of the knee and leg in the anteroposterior, lateral and oblique projections with the bone and soft tissue technics. These studies demonstrated thickening of the soft tissues on the medial aspect of the upper portion of the tibia and knee. At no time was there any evidence of periostitis of the contiguous tibia or ossification or calcification of the tendons in or about the bursa anserina or the lateral ligaments of the knee joint. (Fig. 2.)

The patients were placed in bed and warm or cold compresses were applied to the affected enlarged, tender areas. In one patient where there was an inability to actively completely extend the leg traction to the lower extremity was instituted. In addition, active non-weight bearing quadriceps exercises were initiated soon after admission to the hospital. These three patients were hospitalized for periods varying from thirty to sixty days, and except for one in whom surgical intervention was necessary, resolution of the swelling was a slow process. When the two patients who received conservative therapy were permitted to do excessive amounts of walking or marching, the swelling in the region of the bursa anserina reappeared. However, complete bed rest plus non-weight bearing exercises to the quadriceps led to an almost complete resolution of the prominence. Physical therapy, such as whirlpool baths and infrared radiation, were used effectively to lessen the size of the swelling of the affected region.

In the instance of the patient seen forty-four days after the injury who presented a swelling the size of a small lemon, physiotherapy and periods of rest for thirty days had little effect on the size of the mass. For

Fig. 3. Photograph of one wall of the subcutaneous adventitious bursa reveals the presence of currant jelly-colored elevations in a mosaic arrangement. The polyp is attached to another wall and is not seen in this photograph.

this reason surgical intervention was followed. The exploration revealed that the mass consisted of a subcutaneous adventitious bursa which had a direct channel with the cavity of the contiguous bursa anserina. The subcutaneous bursa was walled by scarred subcutaneous fat and its cavity held about 25 cc. of clear fluid. At the upper pole of this bursal lining was a pendant polyp. The lining of the bursal wall which presented raised circumscribed areas of a currant jelly color joined with the wall of the bursa anserina. In the latter, about 15 cc. of clear fluid and numerous pendant and detached villi were found. The subcutaneous bursa and its polyp as well as the lining of the bursa anserina were removed *in toto*. Resistance quadriceps exercises were initiated forty-eight hours after the operation.

Pathological Findings. The specimen as received measured when opened 4 by 4 by 1/16 cm. and the polyp measured 2½ by 1½ by ½ cm. The lining of the wall of the subcutaneous bursa consisted of brownish-red elevations almost resembling the appearance of a mosaic arrangement of fungus colonies. Some of these single colored areas measured from 0.2 to 0.5 cm. in diameter. (Fig. 3.) Sections of the polyp showed that it consisted primarily of fatty tissue. The lining of the bursa anserina was three times thicker than normal and on its synovial surface were numerous small heart-shaped villi. The microscopic examination showed that the colored areas in the wall of the subcutaneous bursa were the result of deposition of blood pigment and necrosis of part of the subcutaneous fat. The wall of the bursa anserina was thickened and on its lining were numerous small villi. No evidence of infection was present.

The program of conservative treatment and restriction of activities as pursued in the other two patients caused a diminution in the size of the swelling about the bursa anserina. When these patients attempted to perform their regular field duties there was a recurrence of the enlargement of the affected bursa. For this reason they were reassigned to duties which did not require excessive use of their knees. When this was accomplished they had no further difficulties with their legs. In regard to the third patient in whom operative intervention was performed a follow-up examination sixty days after the operation showed that the power of the extensor apparatus of the leg was equal to that of the normal side. No recurrence of swelling was noted in the region of the scar after rigorous exercises. This patient was, therefore, returned to general duty.

COMMENTS

This study has revealed that trauma to the upper portion of the leg may cause hemorrhage in and necrosis of the subcutaneous tissues about the bursa anserina. It is known that the subcutaneous tissues in the upper part of the leg contain a considerable amount of fat which permits free movement of the skin. The looseness of the subcutaneous tissue over the tibia also allows for the inspissation of large amounts

of blood which may lead to the formation of adventitious bursae. When this occurs, as was demonstrated in the one patient in whom surgical intervention was followed, the adventitious subcutaneous bursa may join with that of the contiguous bursa anserina. These abnormal prominences about the medial aspect of the upper leg may lead to an erroneous diagnosis of extra-articular cysts in the semilunar cartilage, bursa of the tibial collateral ligament, osteochondroma of the tibia or ganglions about the hamstring tendons, unless one keeps in mind the possibility of adventitious bursa in conjunction with the bursa anserina. Radiographic examinations made in the oblique view of these three patients disclosed a distinct increase in the thickness of the subcutaneous tissues directly over the medial surface of the proximal end of the tibia and the absence of any distinct localized soft tissue shadow at the level of the semilunar cartilages.

When the soft tissue mass in question diminished in size on rest and physiotherapy, change in the duty status to one which does not entail excessive use of the limbs is indicated. However, when the mass does not alter in size subsequent to the limitation of activities and physiotherapy for at least a thirty-day period, one must suspect villonodular synovitis of the bursal lining. Surgical intervention is necessary to effect a cure in this instance.

CONCLUSION

Severe trauma to the upper portion of the leg as caused by the kick of an animal may result in a fracture of a single bone or a thickening of the soft tissues about the bursa anserina. The latter may be mistaken for an extra-articular cyst or ganglion. When the soft tissues are involved as was noted in three patients the underlying tibia apparently showed no evidence of periostitis. The swelling of the soft tissues may be the result of an adventitious subcutaneous bursa secondary to necrosis of the underlying fat and inspissation of blood. This adventitious bursa may be directly linked to the cavity of the bursa anserina. When the soft tissue prominence does not recede with rest or limitation of activity, as was noted in one patient, surgical removal of the mass is indicated. Conservative therapy, such as physiotherapy, traction and limitation of activity led to a definite amelioration of the symptoms in the other two patients.

REFERENCES

1. Brantigan, O. C. and Voshell, A. F. *J. Bone & Joint Surg.*, 25: 121–131, 1943.
2. Moschowitz, E. *J. A. M. A.*, 109: 1,362–1,363, 1937.
3. Zadek, I. *Bull. Hosp. Joint Dis.*, 3: 125–127, 1942.

COMPARATIVE EVALUATION OF THE EFFECTS OF TALCUM AND A NEW ABSORBABLE SUBSTITUTE ON SURGICAL GLOVES*

JAMES J. EBERL, PH.D., WILLIAM L. GEORGE, LOUIS F. MAY, JR. AND JOHN HENDERSON, M.D.

New Brunswick, New Jersey

THE potential hazards of talcum as a lubricant for surgical gloves have long been a matter of concern. The effects of talc within the peritoneal cavity were investigated in 1919 by Hertzler,[1] and subsequently by Haythorn[2] and Antopol.[3] In 1936 Owen[4] conducted an intensive investigation of the subject and suggested that talc be removed completely from the surface of the gloves before operating. Her findings found support in the work of Feinberg,[5] Ramsey,[6,7] Byron and Welch,[8] Weed and Groves[9] and German.[10]

Lichtman, McDonald, Dixon and Mann,[11] in the course of an extensive study of birefringence in tissues and an investigation of changes in tissues in human beings and laboratory animals produced by doubly refractile foreign bodies made visible by polarized light, offered incontrovertible evidence of the local irritant action of talcum. They found that the characteristic reaction in human tissues consisted of the formation of pseudotubercles and that crystals of talc implanted in artificially created fistulas in dogs caused a persistence of the fistulas. Their findings lent considerable emphasis to the need for an adequate substitute for this irritating substance.

Seelig[12,13] and Seelig, Verda and Kidd[14,15] who have repeatedly warned of the dangers of talc in operative wounds, offered potassium bitartrate and, subsequently, an experimentally produced formaldehyde-treated starch as possible substitutes. Both of these substances have been found to be unsatisfactory for a variety of reasons.

In view of the grave dangers attendant upon the use of talcum, a great deal of effort has been devoted to the search for a satisfactory substitute. Of many compounds tested by the authors and others, in the laboratory and clinically, one has proved so promising as to warrant its introduction for widespread clinical use under practical operating room conditions. This substance consists of a mixture of amylose and amylopectin, derived from corn starch, which has been treated by physical and chemical means to improve its lubricating value and to prevent gelatinization when autoclaved; a small amount (1 per cent) of magnesium oxide is included for the purpose of further improving the flow properties of the mixture. For the sake of convenience this preparation has been designated Biosorb absorbable powder.†

Lee and Lehman[16] found that this material possessed excellent physical qualities of flow and fineness which were largely unaffected by autoclaving and that it was completely absorbable from the peritoneum without inflammatory reaction and without the formation of adhesions. Their clinical experience with the powder, as well as that of Walkling and Lindenmuth,[17] proved eminently satisfactory. MacQuiddy and Tollman[18] who investigated the anaphylactogenic properties of biosorb powder were unable to find any sensitivity to this modified starch in any of the humans tested, nor was it possible to produce a state of sensitivity in animals when this

† Ethicon Suture Laboratories, Division of Johnson & Johnson, New Brunswick, N. J.

* From the Laboratories of Johnson & Johnson, New Brunswick, New Jersey.

substance was used as the anaphylactogen. Their findings further supported the observations of others that this material is non-irritating, is absorbed readily from the peritoneal cavity and appears to be an entirely satisfactory replacement for talcum powder for surgical purposes.

In view of the potential importance of this new powder and the fact that some of the previously offered substitutes (notably potassium bitartrate) have proven inadequate, in part because of their deleterious effects on rubber gloves, it was deemed of interest to conduct a detailed comparison of the relative effects of talcum powder and Biosorb powder on the rates of deterioration of several brands of gloves prepared with these substances and subjected to repeated autoclavings.

It is, of course, well known that steam sterilization alone produces considerable deterioration of surgical rubber gloves, but the question of importance to be determined was whether the rate of this deterioration is accelerated when the gloves are treated with Biosorb instead of talc.

Surgical gloves were purchased from six manufacturers; they comprised several types, including those fabricated from neoprene, white latex and brown latex. The gloves were divided equally into two sets, those in one set being treated in all subsequent procedures with talcum powder and those in the other with Biosorb powder. The preparation of the gloves before each autoclaving followed standard hospital practice as closely as possible. The gloves were washed thoroughly with soap and water, air dried and dusted inside and out with the lubricant powder. A pledget of powder-impregnated gauze was then placed in the cuff of the right hand glove, each pair placed in linen glove folders and autoclaved at 15 pounds pressure (240°F.) for thirty minutes.

After each sterilization the gloves were examined for flaws during moderate distension, washed free of powder and allowed to air dry for a period of twenty-four hours; at the end of this period they again were prepared, respectively, with talcum or Biosorb and autoclaved, the cycle being repeated the requisite number of times.

Tensile strength measurements were made on each set of gloves before sterilization and after groups of three, six and nine consecutive autoclavings. While a number of possible methods of determining the degree of deterioration suggested themselves, it was thought that measurement of the tensile strength probably was the most accurate quantitatively with the facilities available to us. This factor was correlated with the ability of the glove to withstand the stress and strain of application under clinical conditions as a qualitative measure of the point of failure under conditions of practicable use. It was found that, in general, when the tensile strength became less than 1.5 pounds the likelihood of tearing during the act of putting on the gloves, or during subsequent manipulations, was great.

The tensile strengths were determined on sections measuring 0.25 by 2.0 inches (.635 by 5.08 cm.) cut from the gloves with a special die. A Scott tensile strength tester was used with the jaws set at 0.5 inch (1.27 cm.) apart and the results were recorded as pounds pull at the moment of rupture. Since the material used in the manufacture of surgical gloves is not of uniform thickness, thickness measurements were made on each section tested, using a standard thickness micrometer of the type used in determining the diameter of catgut. These determinations were correlated with the tensile strength results, which thus are corrected for differences in thickness of the samples tested; 0.01 inch (0.25 mm.) was taken as the standard thickness. The results are summarized in Table 1. Each result listed in the table represents the average of five determinations per glove. We wish to emphasize that we are not offering these data as absolute values indicating true tensile strengths. The principal interest is in determining relative effects; since each determination was obtained in an identical

TABLE I

COMPARATIVE TENSILE STRENGTH OF SURGEON'S RUBBER GLOVES WHEN TREATED WITH TALCUM AND BIOSORB ABSORBABLE POWDER

POUNDS PULL OF RUBBER SECTION 0.25 BY 0.01 INCH

Brand	I			II			III	IV	V	VI	Grand Averages
Type	White Latex	Brown Latex	Brown Latex	White Latex	Brown Latex	Neoprene	Brown Latex	Brown Latex	White Latex	White Latex	
Control (without any powder and not sterilized)	4.9	2.6	4.4	2.6	4.9	6.6	4.3	2.4	5.2	5.0	
	5.8	4.3	4.3	5.0	5.1	5.2	4.1	2.9	4.5	5.2	
	4.0	3.8	5.2	4.9	5.5	2.8	4.4	2.6	5.1	5.2	
	3.6	2.8	5.1	5.8	3.5	3.0	4.2	2.6	5.0	4.1	
	5.4	2.8	4.2	3.3	4.7	5.6	4.8	2.0	5.3	5.4	
$\bar{X}$	4.9	3.3	4.6	4.3	4.7	4.6	4.4	2.4	5.0	5.0	$\bar{\bar{X}}$ 4.32
Biosorb absorbable powder 3 sterilizations	4.8	1.9	2.9	3.3	3.6	1.7	3.8	1.8	3.0	1.4	
	3.1	2.1	3.1	3.4	4.0	2.1	3.6	2.0	4.0	1.4	
	2.9	2.2	3.1	4.0	4.5	5.1	2.2	1.6	2.5	1.2	
	4.0	2.4	4.0	3.7	5.5	2.2	3.6	2.1	3.5	1.5	
	3.2	2.0	3.9	3.7	4.2	8.2	3.4	0.8	2.7	1.2	
$\bar{X}$	3.6	2.1	3.4	3.6	4.4	3.9	3.3	1.7	3.1	1.3	$\bar{\bar{X}}$ 3.04
Talcum powder 3 sterilizations	3.6	2.2	3.7	3.6	5.4	4.6	3.1	1.8	2.8	1.2	
	3.2	2.0	3.2	3.7	5.2	4.5	2.7	1.7	1.3	1.2	
	3.2	2.2	2.5	4.3	3.5	3.6	4.1	1.5	1.8	1.3	
	3.4	1.8	2.8	4.1	4.8	6.1	3.2	1.2	1.9	1.2	
	2.6	1.8	3.7	3.7	4.6	2.2	3.2	0.9	2.5	1.0	
$\bar{X}$	3.2	2.0	3.2	3.9	4.7	4.2	3.3	1.4	2.1	1.2	$\bar{\bar{X}}$ 2.92
Biosorb absorbable powder sterilizations	1.8	1.7	2.6	2.7	3.8	5.2	1.9	1.1	2.6	0.8	
	2.1	1.8	2.6	1.6	1.8	3.8	2.2	0.6	2.4	0.6	
	2.2	1.3	2.9	2.7	3.1	1.8	3.8	0.9	1.9	0.6	
	2.2	1.6	2.6	2.5	2.4	2.2	2.4	0.5	2.4	0.6	
	2.5	1.3	3.1	2.5	3.1	5.1	3.0	0.7	2.4	0.5	
$\bar{X}$	2.2	1.5	2.8	2.4	2.8	3.6	2.7	0.8	2.3	0.6	$\bar{\bar{X}}$ 2.17
Talcum powder 6 sterilizations	1.9	1.6	2.0	2.9	3.6	4.6	3.3	0.9	2.0	0.8	
	1.8	1.2	3.0	2.0	2.6	2.5	2.0	0.9	1.1	0.7	
	1.9	1.5	2.3	2.8	2.3	1.8	1.9	0.7	1.7	0.7	
	2.7	1.2	2.4	2.3	2.6	2.4	1.9	1.0	2.0	0.6	
	2.5	1.2	1.9	2.0	2.6	2.2	2.4	0.8	2.3	0.7	
$\bar{X}$	2.2	1.3	2.3	2.4	2.7	2.7	2.3	0.9	1.8	0.7	$\bar{\bar{X}}$ 1.93
Biosorb absorbable powder 9 sterilizations	1.5	1.1	1.7	1.6	2.7	5.8	2.1	0.6	2.3	0.5	
	2.7	1.0	1.6	1.8	3.0	3.2	1.7	0.6	1.9	0.5	
	1.6	1.6	2.0	2.3	2.8	6.5	2.7	1.1	1.4	0.5	
	1.6	1.1	2.1	2.1	2.8	4.9	1.7	0.6	1.5	0.6	
	2.2	1.1	1.4	1.8	4.2	2.8	3.2	0.5	1.4	0.4	
$\bar{X}$	1.9	1.2	1.8	1.9	3.1	4.6	2.3	0.7	1.7	0.5	$\bar{\bar{X}}$ 1.97
Talcum powder 9 sterilizations	1.6	1.7	1.6	2.3	3.1	7.4	1.8	0.5	1.2	0.5	
	1.6	1.2	1.8	2.4	2.8	5.0	2.1	0.7	1.0	0.3	
	1.7	.7	1.6	2.7	2.7	2.9	1.6	0.6	1.5	0.4	
	1.8	.9	1.7	2.2	2.7	3.8	1.6	0.8	0.6	0.2	
	1.7	.9	1.6	1.7	2.8	2.1	1.8	0.5	1.0	0.3	
$\bar{X}$	1.7	1.1	1.7	2.3	2.8	4.2	1.8	0.6	1.1	0.3	$\bar{\bar{X}}$ 1.76

$\bar{X}$ = Average of five tests.

manner, the various data are comparable on a relative basis. The respective brands are designated by Roman numerals.

An analysis* of the data in Table 1 indicates considerable variability among the tensile strengths of surgeons' gloves of various types and between gloves of a given manufacturer, even before preparatory dusting and sterilization. Initial observation without the benefit of such an

*We are indebted to Mr. E. H. MacNiece for a statistical analysis of our data.

analysis might create flash impressions as to the superiority of either lubricant but analysis shows that the gloves treated with the absorbable powder averaged 4 per cent stronger than gloves treated with talc, after three sterilizations. After six and nine sterilizations, Biosorb powder-treated gloves averaged about 12 per cent stronger than those treated with talc.

To determine the significance of the difference between the effects of the two lubricants on the degradation of tensile strength, a "t" test was made. The "t" value between the two lubricants computed on the thirty, paired, averaged, tensile strengths of groups of five samples is 3.16 with 29 degrees of freedom, indicating a highly significant difference in favor of the Biosorb powder. The interaction between the types of lubricant and types of fabric is insignificant, indicating that Biosorb powder retards the degrading effect of steam sterilization on the tensile strength of all three types of rubber.

With the brand of glove manifesting the least rapid rate of deterioration the fatigue point was not reached until the gloves had been subjected to nine autoclavings, regardless of whether talc or Biosorb powder was used as the lubricant. This fact is of considerable importance from the standpoint of operating room administration since there is considerable variation among all types of gloves in the inherent susceptibility of the material to autoclaving and adverse rates of deterioration are by no means necessarily attributable to the lubricating powder used in preparing the gloves.

This study statistically indicates a betterment in glove life and reliability by the use of Biosorb powder and it is clear on empirical grounds that this powder does not produce a more rapid rate of deterioration in comparison with that which occurs during steam sterilization when talc is used as the dusting agent. Thus, the factor of adverse effect upon rubber gloves is not encountered in avoiding the obvious hazards of talcum powder when this absorbable modified starch is used as the replacing agent.

SUMMARY AND CONCLUSIONS

1. A series of rubber gloves obtained from six manufacturers were divided into two sets and subjected to a comparative series of autoclavings after treatment, respectively, with talcum and a new absorbable starch powder.

2. The respective rates of deterioration were compared; it was found that when the absorbable powder was used the degradation in the tensile strength of the gloves produced by autoclaving occurred less rapidly upon repeated sterilizations than when talcum was used as the dusting agent.

3. The effect of this absorbable powder on rubber gloves does not constitute a drawback to its use as a replacement for talcum powder as a lubricating agent.

REFERENCES

1. Hertzler, Arthur E. The Peritoneum. St. Louis, 1919. C. V. Mosby Co. 2: 713.
2. Haythorn, Samuel R. Nodular lesions of the peritoneum. *Am. J. Path.*, 9: 725–737, 1933.
3. Antopol, W. Lycopodium granuloma. *Arch. Path.*, 16: 326–331, 1933.
4. Owen, May. Peritoneal response to glove powder. *Texas State J. Med.*, 32: 482–485, 1936–37.
5. Feinberg, Robert. Talcum powder granuloma. *Arch. Path.*, 24: 36–42, 1937.
6. Ramsey, Thomas L. and Douglass, Fred M. Granulomatous inflammation produced by foreign body irritants. *J. Internat. Coll. Surgeons*, 3: 3–10, 1940.
7. Ramsey, Thomas L. Magnesium silicate granuloma. *Am. J. Clin. Path.*, 12: 553–558, 1942.
8. Byron, F. X. and Welch, G. Stuart. A complication from the use of glove powder. *Surgery*, 10: 766–769, 1941.
9. Weed, L. A. and Groves, J. L. Surgical gloves and wound infections. *Surg., Gynec. & Obst.*, 75: 661–664, 1942.
10. German, W. M. Dusting powder granulomas following surgery. *Surg., Gynec. & Obst.*, 76: 501–507, 1943.
11. Lichtman, A. L., McDonald, J. R., Dixon, C. F. and Mann, F. C. Talc granuloma. *Surg., Gynec. & Obst.*, 83: 531–546, 1946.
12. Seelig, M. G. Abdominal silicosis (due to talcum powder) and cancer. *S. Clin. North America*, 24: 1162–1171, 1944.

13. Seelig, M. G. Talcum as an operating room hazard. *South. M. J.*, 38: 470–472, 1945.
14. Seelig, M. G., Verda, D. J. and Kidd, F. H., Jr. The talcum powder problem in surgery and its solution. *J. A. M. A.*, 123: 950–954, 1943.
15. Seelig, M. G., Verda, D. J. and Kidd, F. H., Jr. The talcum powder problem in surgery and its solution. *Proc. Interst. Postgrad. M. A. North America*, 205–208, 1943.
16. Lee, C. M., Jr. and Lehman, E. P. Experiments with non-irritating glove powder. *Surg., Gynec. & Obst.*, 84: 689–695, 1947.
17. Walkling, A. A. and Lindenmuth, W. W. Personal communication. (To be published.)
18. MacQuiddy, E. L. and Tollman, J. P. Observations on an absorbable powder to replace talc. (To be published.)

Certain living tissues will grow in a medium consisting of Tyrode's solution, buffered salt solution, heparinized plasma and embryonic extract. Neither the plasma nor the embryonic extract need come from the same species of animal.

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea & Febiger).

SURGICAL COMPLICATIONS OF INTESTINAL TUBERCULOSIS AS SEEN AT NECROPSY*

STANLEY A. KORNBLUM, M.D., CHARLES ZALE, M.D.
Surgical Resident, Montefiore Hospital
AND
WILLIAM ARONSON, M.D.
Director of Laboratories, Morrisania City Hospital
New York, New York

IT is well known that the incidence of intestinal tuberculosis is high in known pthisic patients who are seen at autopsy. Various authors[1-3] have reported percentages that vary from 50 to 90 per cent. Blumberg[4] in his study on the incidence of intestinal tuberculosis, classified the pulmonary lesion as seen at autopsy into far advanced, moderately advanced and early cases. He then found that the incidence of intestinal tuberculosis varied markedly with the severity of the pulmonary lesion; 70 to 80 per cent of the far advanced pulmonary cases showed intestinal involvement, 14 to 18 per cent of the moderately advanced and only 5 to 8 per cent of the early cases showed involvement. Quite naturally all of these reports have come from tuberculosis institutions.

TABLE 1
FORTY-EIGHT CASES OF INTESTINAL TUBERCULOSIS

Location of Lesions	Number	Percentage
Jejunum	5	5.87
Ileum	26	30.59
Upper 5		
Lower 21		
Cecum	18	21.19
Appendix	2	2.35
Ascending colon	9	10.59
Transverse colon	6	7.06
Descending colon	6	7.06
Sigmoid colon	4	4.70
Rectum	2	2.35
Diffuse involvement of small and large bowel	7	8.24
Total	85	100%

INCIDENCE OF PULMONARY AND INTESTINAL TUBERCULOSIS

There have been no reports in recent years on the incidence of pulmonary tuberculosis and its intestinal complications in general hospitals. A review of 4,200 consecutive autopsy protocols at Morrisania City Hospital from 1930 to 1946 revealed an incidence of 4.05 per cent (170 cases) of active pulmonary tuberculosis. In this group of 170 pthisic patients there was an incidence of intestinal tuberculosis of only 28.23 per cent (forty-eight cases). The sites of predilection were the ileum and cecum. (Table 1.)

The figure of 28.23 per cent is considerably lower than that reported in the current literature[3] and text books;[1,2] however it must be emphasized that the material in this series comes from a general hospital. Our patients with tuberculosis are transferred as expeditiously as possible to tuberculosis institutions once the diagnosis is made. This state of affairs naturally tends to limit our patients to those that were unsuspected prior to admission and to those who were acutely ill and could not be transferred.

Because of this situation one would suspect that the incidence of complications in intestinal tuberculosis would tend to be higher in institutions such as ours despite the smaller number of cases. This point

* From the Department of Pathology, Morrisania City Hospital, New York, N. Y.

was brought home to the authors who saw at necropsy in a relatively short period of time a case of intestinal obstruction and another of generalized peritonitis due to perforation of the small bowel; both cases being secondary to intestinal tuberculosis.

TABLE II
FORTY-EIGHT CASES OF INTESTINAL TUBERCULOSIS

	Number	Percentage
Perforated with generalized peritonitis	5	10.42
Site of Perforations		
Ileum	3	
Sigmoid	1	
Small and large bowel (multiple)	1	
Feces in peritoneal cavity	2	
Age range—15 to 66 years {Male	2	
Age range—15 to 66 years {Female	3	
Operated ante-mortem	2	
Intestinal Obstruction	6	12.50
Adhesions	5	
Stenosis secondary to scar tissue	1	
Age range 21–77 years {Male	2	
Age range 21–77 years {Female	4	
Operated ante-mortem	3	

PERFORATION IN INTESTINAL TUBERCULOSIS

Some authors[5,6] lay great stress on the danger of intestinal obstruction in ulcerative intestinal tuberculosis if and when it heals. The question of acute perforation with generalized peritonitis is not stressed. The consensus of opinion[2,5,7,8,9,15] is that perforation is uncommon; if it does occur, the process is a slow one with a localized peritoneal reaction and a walling-off of the perforation.

The criteria for the diagnosis of acute perforation of the bowel at necropsy were: (1) Demonstration of the perforation and (2) generalized peritonitis with either feces and/or pus in the peritoneal cavity. Five patients out of our forty-eight cases of intestinal tuberculosis met these criteria, an incidence of 10.42 per cent. (Table II.)

The figure of 10.42 per cent is significantly higher than the incidences for perforation reported from tubercular institutions. Brown and Sampson[10] found that only 3.7 per cent of their patients had complete or incomplete perforation. Cullen[3] in a review of over 700 cases of intestinal tuberculosis seen at necropsy at Seaview Hospital found that only 3.81 per cent had perforations. While our series is small, the fact remains that over a period of sixteen years 10.42 per cent of our patients with intestinal tuberculosis seen at autopsy had complete perforation with generalized peritonitis. The current foreign literature[16–18] contains case reports which serve to emphasize this fact.

OBSTRUCTION IN INTESTINAL TUBERCULOSIS

Boyd,[1] Portio[7] and Barrow[11] all believe that the most common cause of intestinal obstruction in intestinal tuberculosis is adhesions rather than stenosis secondary to cicatrization following the healing of the intestinal lesions. Brown and Sampson[10] in their book on intestinal tuberculosis state "stenosis is infrequent in secondary intestinal tuberculosis as the patient usually dies before sufficient healing takes place."

There were six patients in our series of intestinal tuberculosis that showed intestinal obstruction, an incidence of 12.50 per cent. Five of these cases were due to adhesions and one to stenosis. (See Table II.) This latter patient was a fifty-two year old male who had known pulmonary tuberculosis for twenty years.

Barrow[11] in reporting on sixty-seven cases of tuberculous peritonitis found that nine of them were operated upon for intestinal obstruction due to adhesions only. This is an incidence of 13.43 per cent which compares favorably with the incidence of 12.50 per cent obtained at autopsy in this series.

PRIMARY INTESTINAL TUBERCULOSIS

There have been reports[12,14] in recent literature of primary tuberculosis of the intestines; however, most authors[7,8,9,12,13,14] are agreed that although primary tuberculosis of the intestines can occur it is extremely rare. Bockus[8] states that the literature contains very few instances of

primary ulcerative intestinal tuberculosis in persons beyond eight years of age. He lays down the following criteria for diagnosis: (1) Characteristic histological picture; (2) demonstration of acid-fast bacilli in the intestinal lesion; (3) absence of tuberculosis in other parts of the body and (4) transference of the infection to laboratory animals.

Crohn and Yarnis[14] in an excellent review of the subject laid down similar criteria for diagnosis. These authors surveyed all the autopsies (4,800) and surgical material at Mt. Sinai Hospital from 1926 to 1938. Among the necropsies they found only one case and among the surgical material only seven cases that they felt were primary intestinal tuberculosis.

Among our 4,200 necropsies, we found only one case that may be considered as one of isolated or primary tuberculosis of the intestines. Because of the rarity of this condition, we wish to present the case report* and autopsy findings in brief.

CASE REPORT

A sixty-six year old white male was admitted to Morrisania City Hospital on April 26, 1946, and died on April 28, 1946. The patient had been in this hospital several times since 1936 for a fractured rib, fractured humerus and chronic alcoholism.

He was admitted complaining of abdominal pain and vomiting of five days' duration. The pain was knife-like and peri-umbilical at the beginning but it gradually shifted to the lower abdomen. The vomitus was "brownish material." He had passed some flatus and a watery stool on the day of admission. There was no history of diabetes, tuberculosis or cardiac disease. The patient had lost 20 to 30 pounds in the past year. There were no other gastrointestinal complaints.

The physical examination revealed the following positive findings. Temperature 101.2°F., pulse 120, respirations 40 and blood pressure 114/70. The patient was relatively comfortable. The abdomen was tympanitic and there was generalized rigidity, tenderness and rebound. These findings were most marked in the right upper and right lower quadrants. Rectal examination revealed tenderness above and lateral to prostate. The blood count was white blood cells 5,150, polymorphonuclears 59 per cent, lymphocytes 38 per cent and monocytes 3 per cent. An *x*-ray of the abdomen in the upright position revealed air under the diaphragm.

The patient was sent to surgery for an exploratory laparatomy. His postoperative temperature ranged from 101° to 103°F. and his pulse was from 90 to 120. He developed cardiac arrthymia which became normal after digalin therapy. On the second postoperative day the patient developed pulmonary edema and made an exodus.

At necropsy the patient was found to have a perforation in the ileum and generalized peritonitis. When the ileum was opened a sharp stricture was found about 3 feet proximal to the ileocecal valve. At this point there were several small ulcers girdling the bowel which was thickened and firm. Spreading proximally to this for a distance of 4 cm. was a softer, more red and acute looking, sharp-edged ulceration that had a perforation. The rest of the organs were normal.

Microscopic sections through the perforated ulcer revealed the typical histopathology of tuberculosis. Acid-fast organisms were demonstrated in the microscopic sections. Unfortunately no animal inoculations were done. No evidence of active tuberculosis or open lesion was found by *x*-ray or at autopsy.

The presumptive diagnosis in this case is primary tuberculosis of the ileum with perforation and generalized peritonitis.

SUMMARY AND CONCLUSIONS

1. Review of 4,200 consecutive autopsy protocols in a general hospital revealed the incidence of pulmonary tuberculosis to be 4.05 per cent (170 cases).

2. The incidence of intestinal tuberculosis among the active pulmonary tuberculous cases was 28.23 per cent (48 cases).

3. The most frequent site of involvement in intestinal tuberculosis is the lower ileum and the cecum.

4. The incidence of intestinal perforation with generalized peritonitis in intestinal tuberculosis was found to be 10.42 per cent

* From Surgical Service of Dr. Joseph Deutsch, Morrisania City Hospital.

which is much higher than has been reported from tuberculosis institutions.

5. The incidence of intestinal obstruction in intestinal tuberculosis was 12.50 per cent. The most common cause of intestinal obstruction is adhesions and not stenosis secondary to cicatrization.

6. The incidence of surgical complications (perforation and obstruction) in intestinal tuberculosis in a general hospital is high (22.92 per cent) despite the small number of patients seen.

7. A case history and necropsy findings of a case of primary tuberculosis of the ileum with perforation and generalized peritonitis was presented.

REFERENCES

1. Boyd, W. Pathology of Internal Disease. 2nd ed. Pp. 310–316. Philadelphia, 1936. Lea & Febiger.
2. Goldberg. Clinical Tuberculosis. 4th revised ed. H 10 to H 23. Philadelphia, 1944. F. A. Davis Co.
3. Cullen, J. H. Intestinal tuberculosis, a clinical pathological study. *Quart. Bull. Sea View Hosp.*, 5: 143–160, 1940.
4. Blumberg, A. Pathology of intestinal tuberculosis. *J. Lab. & Clin. Med.*, 13: 405, 1928.
5. Levine, S. J. Intestinal tuberculosis. *Rocky Mountain M. J.*, 37: 678–681, 1940.
6. Boyd, W. Surgical Pathology. 4th ed. Pp. 300–311. Philadelphia, 1939. W. B. Saunders Co.
7. Portio, S. A. Diseases of the Digestive System. Pp. 324–344. Philadelphia, 1941. Lea & Febiger.
8. Bockus, H. L. Gastroenterology. Vol. 2. Pp. 197–226. Philadelphia, 1943. W. B. Saunders Co.
9. Riggins, H. Mc. Tuberculosis of the ailmentary tract. *M. Clin. North America*, 26: 819, 1942.
10. Brown, L. and Sampson, H. Intestinal Tuberculosis. Philadelphia, 1926. Lea & Febiger.
11. Barrow, D. W. Tuberculous peritonitis. *South. M. J.*, 36: 646, 1943.
12. Bockus, Tumen and Kornblum. Diffuse primary tuberculous enterocolitis, report of two cases. *Ann. Int. Med.*, 13: 1,461–1,482, 1940.
13. MacCallum, W. G. Textbook of Pathology. 6th ed. Pp. 648–652, Philadelphia, 1937. W. B. Saunders Co.
14. Crohn, B. and Yarnis, H. Primary ileo-caecal tuberculosis. *New York State J. Med.*, 40: 158, 1940.
15. Kaufman, E. Pathology for Students and Practitioners. Vol. 1. Pp. 796–802, Philadelphia, 1929. The Blakiston Co.
16. Black, R. C. Perforated tuberculosis ulcer of the bowel. *M. J. Australia*, 30: 579–580, 1943.
17. Dussaut, A. and diLaudo, R. Tuberculosis ulcer of small intestine perforated into free peritoneum. *Dia méd.*, 16: 764–765, 1944.
18. Lamberti, C. E. Perforation of ulcers (tuberculous), with report of cases. *An. Cáted de pat. y clín. tuberc.*, 3: 397–411, 1941.

Case Reports

TRANSPYLORIC HERNIATION OF REDUNDANT GASTRIC MUCOSA

K. K. Nygaard, M.D. and Alexander Lewitan, M.D.
New York, New York

In an investigation concerning mechanical causes of so-called "gastric ileus," Meyer and Singer,[1] in 1931 noted that von Schmieden,[2] twenty years earlier, had fully described a case of gastric mucosa prolapsing into the duodenum. A partial translation of this case report was presented in their paper. In von Schmieden's words, "Such a finding up to now has not been described in the literature."

In 1926 Eliasen, Pendergrass and Wright[3] reported two similar cases. They stated that these "are the first two cases that have been reported to our knowledge." This must have been a slight slip, not because von Schmieden's case had been overlooked; the latter, hidden as it is in an extensive publication, is not easy to find even with the correct reference. However, Eliasen and Wright,[4] in 1925, described fully a similar case which appears not identical with any of the two cases in their subsequent report.

Since then several reports have appeared. namely: by Meyer and Singer,[1] one case (1931); Pendergrass and Andrews,[5] three cases (1935); Rees,[6] four cases, (1937); Bohrer and Copelman,[7] one case (1938); Archer and Cooper,[8] four cases (1939); Melamed and Hiller,[9] one case (1943); and Norgore and Schuler,[10] two cases (1945).

In a discussion of non-malignant lesions of the stomach, Eusterman and Balfour[11] (1935) briefly mention two cases which apparently fall into the category of the present survey although no detailed presentation is given.

In a recent report, Scott[12] describes his experience from a large Naval hospital, where, in 1,346 roentgen examinations of the upper gastrointestinal tract a prolapse of the gastric mucosa was found in fourteen patients, that is, 1.04 per cent. Interestingly, "In this group of young and adult men, prolapse of gastric mucosa occurred as often as gastric ulcer."

We have made the diagnosis of prolapsing gastric mucosa in seven patients in some 800 successive gastrointestinal x-ray examinations. In addition, a minimal prolapse of redundant gastric mucosa was present in six patients with gastric ulcer.

It is somewhat unexpected that since von Schmieden's original report, the subsequent publications concerning this condition all have appeared in American literature only. One has the notion that subsequently others may be pointed out and previously overlooked because of nonspecific titles.

From this survey one is left with the impression that in spite of the relatively few cases reported, this type of gastric pathologic condition may prove not as uncommon as one might have been led to believe. With increasing knowledge of the characteristic roentgenologic appearance of prolapsed gastric mucosa, it seems probable that some patients previously listed under the headings of gastric neurosis or psychosomatic disorder, upon re-examination may be found to fall into the group of organic gastric disorders. Without the knowledge of even the existence of such a

condition, we, in our own limited experience, would not have been prevented from making the incorrect diagnosis of functional disorder in two instances at least.

In the case reports a varying terminology is employed, namely, herniation, intussusception, prolapse or extrusion of gastric mucosa through the pylorus. Although the term extrusion may be the more correct form, as pointed out by Norgore and Schuler,[10] use of the other terms would not be likely to lead to confusion as to the actual condition, namely, the existence of a redundant fold or folds of the antral gastric mucosa protruding through the pylorus into the duodenum.

Unexpectedly, inaccuracies are noted in the literature due to inclusion of herniated "gastric mucosal lesions," that is, benign or malignant tumors. The similarity in anatomic location and mechanical peculiarities resulting therefrom, seem not sufficient to consider them under the same heading with true antral mucosal extrusions.

Before proceeding with a further discussion of this condition, the following report may be of interest:

CASE REPORTS

Case 1. The patient was a Norwegian, forty-five years of age, who had worked as a seaman throughout his adult life. An older brother had been operated upon, allegedly for "stomach ulcer." A younger sister had been medically treated for a "duodenal ulcer."

The patient had had "influenza" during the flu epidemic of 1918. In 1934 he had been successfully operated upon for left-sided inguinal hernia.

The onset of his present condition dated back to 1933 when he suffered from dyspepsia for a period of three months. Since its onset the distress has been intermittent. Episodes of distress of a couple of weeks up to eight months' duration would alternate with periods of reasonable freedom from distress. Particularly distressing periods had been present in 1933, 1934, 1937, 1941, 1942, 1944 (for ten months) and from November, 1945, to the time of admission to White Plains Hospital.

The subjective symptoms during periods of distress had not essentially changed in character over the years, excepting an increased intensity of the distress and longer-lasting distressing periods. The patient volunteered the suggestion that the aggravation of late may have resulted from the nervous tension aboard ship during World War II, with ever lurking danger of torpedoeing, mines and bombing.

The distressing periods would be characterized by epigastric fullness and distention, with griping non-radiating pain in the midepigastrium, followed by frequent eructation, nausea and vomiting. The distress would frequently come on immediately after or while eating. It would instantly be improved upon spontaneous or induced vomiting. It never occurred at night. The patient never suffered from hunger pain. He had not experienced any particular relief after the intake of alkalis. He was under the impression that during the active periods of distress it made no difference what kind of food he ate; even water would then frequently bring on pain and vomiting.

On several occasions the patient had had hematemesis, followed shortly by the passage of tarry stools for a few days. Hematemesis and melena had been noted for the first time in 1933; since then repetition of these phenomena had occurred in 1937, 1942 and 1944. Following the gastrointestinal hemorrhage in 1944, the patient was investigated at a hospital elsewhere, during which time no definite cause of the gastrointestinal hemorrhage could be ascertained. The patient convalesced for eight months before signing aboard ship again.

In November, 1945, his subjective distress recurred. Because of sickness he signed off his ship in New York at the beginning of January, 1946. This incident was duly celebrated by what was termed a moderate spree. On January 6, 1946, following profuse vomiting of blood, the patient collapsed and was admitted to a hospital while unconscious where he remained until February 12, 1946. Investigations failed to reveal the definite cause of the bleeding. Roentgen rays of the gastrointestinal tract did not reveal the presence of ulcerations or tumors. However, it was observed that there was pronounced prominence of the gastric rugae. After the effect of the acute hemorrhage had been overcome by blood transfusions, the patient was started on a dietary medical regime. On February 4, 1946, a hemorrhoidectomy was

FIG. 1. For comparative purposes the normal pyloric canal, the normal duodenal bulb and normal mucosal pattern of the bulb are illustrated in two normal cases, A and B.

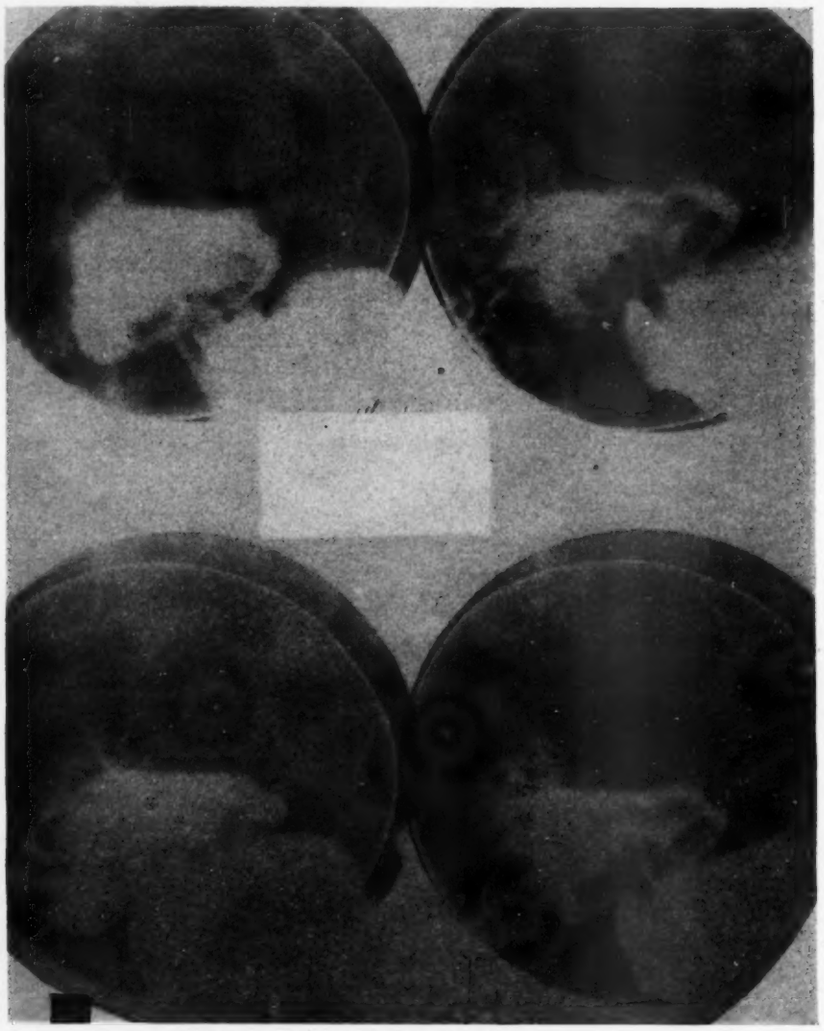


FIG. 2. Case 1. Serial studies of the duodenal bulb under compression with patient in the erect position. Characteristic gastric folds which appear to be continuous with the prepyloric folds are seen within the base of the duodenal bulb.

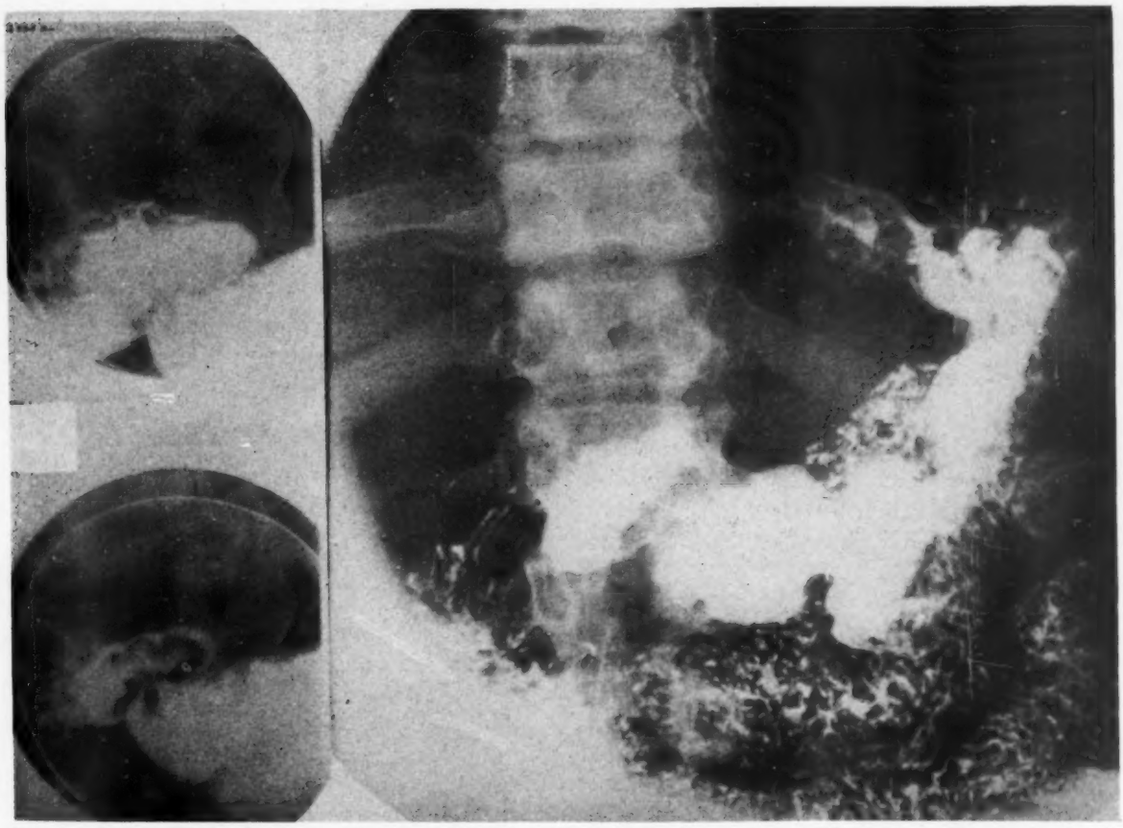


FIG. 3. Case 1. The wide open pyloric canal and the changing pattern of the prolapsed gastric mucosa, coincident with the antral systole and diastole. In the survey film on the right the large gastric rugal pattern can be recognized.

likewise performed. After his dismissal the patient continued the dietary regime at a nursing home.

In spite of a prolonged convalescence with a carefully supervised dietary regime, the patient continued to complain of frequent epigastric distress and vomiting; there was no further recurrence of the gastrointestinal hemorrhage. The patient therefore was referred to the Norwegian Public Health Service, New York, for further investigation. X-ray investigations were performed by one of the authors, Dr. Lewitan, on two different occasions and revealed the following: (Figs. 1, 2 and 3.)

The esophagus was fluoroscopically negative. Stomach was normal in size and position. There was a moderate amount of secretion present at the onset of the examination. The stomach walls were completely pliable. The gastric rugae appeared to be considerably enlarged. There was no evidence of gastric ulceration or other intrinsic pathologic symptom. The pyloric opening was immediate and the pylorus appeared to be wide open. The gastric emptying time was increased. Within the base of the duodenal bulb, on moderate compression, translucent bands were apparent which were continuous with the prepyloric gastric rugae. There was scalloping at the apex of the bunched-together prolapsed gastric folds. The contour was constantly changing and the relative volume of the prolapsed gastric folds appeared to increase with antral systole. In antral diastole the gastric folds were seen in the juxtapyloric region. The base of the duodenal bulb appeared unusually broad. Even in antral systole the pyloric ring appeared very wide. At times the resemblance to a small cauliflower was pronounced. The findings were present with the patient in the erect as well as recumbent positions. In supine views it was absent. No other significant findings were present on roentgenographic and radiographic examinations of the remaining gastrointestinal tract. The same findings were obtained on the second examination after the patient had had a renewed medical regime from March 12th to April 20th. The only significant change seemed

FIG. 1. For comparative purposes the normal pyloric canal, the normal duodenal bulb and normal mucosal pattern of the bulb are illustrated in two normal cases, A and B.

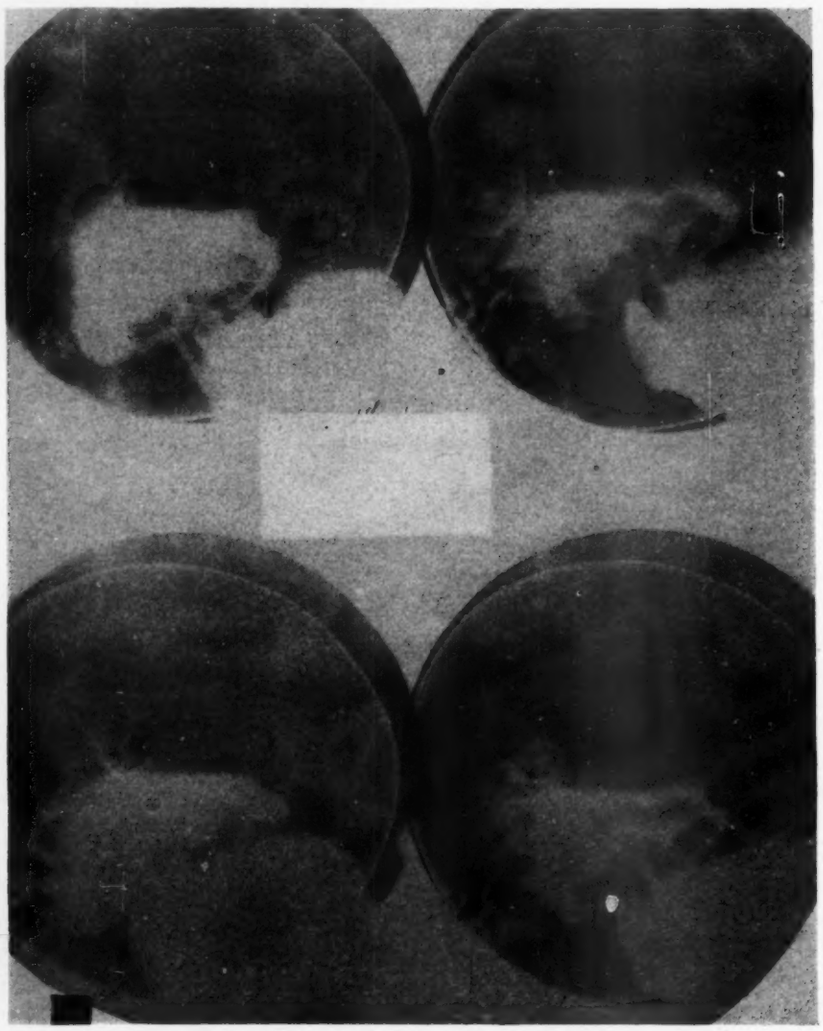


FIG. 2. Case 1. Serial studies of the duodenal bulb under compression with patient in the erect position. Characteristic gastric folds which appear to be continuous with the prepyloric folds are seen within the base of the duodenal bulb.

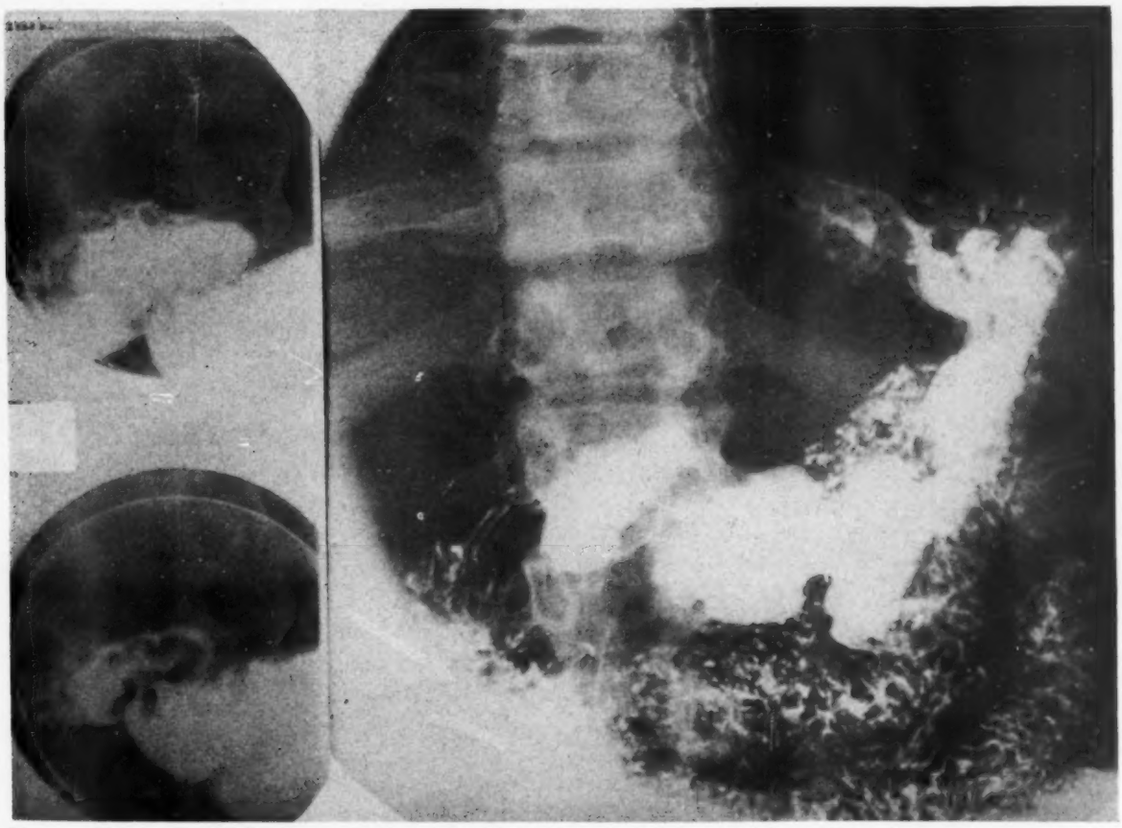


Fig. 3. Case 1. The wide open pyloric canal and the changing pattern of the prolapsed gastric mucosa, coincident with the antral systole and diastole. In the survey film on the right the large gastric rugal pattern can be recognized.

likewise performed. After his dismissal the patient continued the dietary regime at a nursing home.

In spite of a prolonged convalescence with a carefully supervised dietary regime, the patient continued to complain of frequent epigastric distress and vomiting; there was no further recurrence of the gastrointestinal hemorrhage. The patient therefore was referred to the Norwegian Public Health Service, New York, for further investigation. X-ray investigations were performed by one of the authors, Dr. Lewitan, on two different occasions and revealed the following: (Figs. 1, 2 and 3.)

The esophagus was fluoroscopically negative. Stomach was normal in size and position. There was a moderate amount of secretion present at the onset of the examination. The stomach walls were completely pliable. The gastric rugae appeared to be considerably enlarged. There was no evidence of gastric ulceration or other intrinsic pathologic symptom. The pyloric opening was immediate and the pylorus appeared to be wide open. The gastric emptying time was increased. Within the base of the duodenal bulb, on moderate compression, translucent bands were apparent which were continuous with the prepyloric gastric rugae. There was scalloping at the apex of the bunched-together prolapsed gastric folds. The contour was constantly changing and the relative volume of the prolapsed gastric folds appeared to increase with antral systole. In antral diastole the gastric folds were seen in the juxtapyloric region. The base of the duodenal bulb appeared unusually broad. Even in antral systole the pyloric ring appeared very wide. At times the resemblance to a small cauliflower was pronounced. The findings were present with the patient in the erect as well as recumbent positions. In supine views it was absent. No other significant findings were present on roentgenographic and radiographic examinations of the remaining gastrointestinal tract. The same findings were obtained on the second examination after the patient had had a renewed medical regime from March 12th to April 20th. The only significant change seemed

a slight regression in the general caliber of the gastric rugae.

On May 5, 1946, the patient was admitted to White Plains Hospital. He was in good nutritional status, of the stocky type, with no history of weight loss and weighed 185 pounds. His height was 5 feet, 8 inches. His blood pressure was 115 mm. Hg systolic and 80 mm. diastolic. A carefully performed physical examination revealed no demonstrable pathologic findings except slight tenderness to deep pressure in the area of the mid-epigastrium. Laboratory examinations revealed 4,700,000 erythrocytes per cu. mm. with 13.4 Gm. hemoglobin; leukocytes numbered 7,900 with normal differential count. Plasma proteins were 6.4 Gm. per cent; chlorides, 620 mg. per cent. Stool examination did not indicate the presence of occult blood.

Following the Ewald test meal, at the end of one hour no free hydrochloric acid was found, and the total acidity was 15 units.

Following preoperative preparation, the patient was submitted to an operation on May 9, 1946, by Dr. Nygaard; this was performed under continuous spinal anesthesia.

A careful investigation of the intra-abdominal organs revealed no demonstrable pathologic condition excepting that pertaining to the stomach and duodenum. The duodenum was free of adhesions, deformity or palpable induration of the anterior or posterior duodenal wall. There were no indurations of the head of the pancreas and no adhesions between the posterior aspects of the stomach and the peripancreatic capsule. On the basis of the preoperative x-ray diagnosis, particular attention was directed toward the pyloric and prepyloric areas. Careful inspection of this area did not reveal any demonstrable pathologic disease; in particular there were no irregularities of the anterior wall nor any visible bulging areas. Finger palpation at first gave the impression of a peculiar thickening of the pyloric segment. By "milking" the prepyloric area with one finger anteriorly and one posteriorly, one had the sensation that this thickened area could be moved up and down. By slowly moving the two compressing fingers from the prepyloric area in distal direction, the sensation of an elastic induration would abruptly cease about 1.5 to 2 cm. distal to the pyloric vein. By then moving the fingers again slowly in a proximal direction, the first part of the duodenum and the pyloric ring would feel perfectly normal, while the prepyloric area again would give the sensation of fullness. One was also struck by the fact that while at one moment finger palpation gave the impression of a certain, definite configuration of the elastic induration, during the next moment this may have changed or disappeared. The remainder of the stomach appeared normal.

As is obvious also from the several reports in the literature concerning the surgical treatment to be chosen, the surgeon is confronted with a decision as to the procedure preferable in the individual patient. In the subject herein described we believed that the repeated and occasionally very severe episodes of gastrointestinal hemorrhages weighed heavily in favor of a partial gastric resection; the latter procedure was therefore adopted, removing about 70 per cent of the stomach. The remaining segment of the stomach was joined with the jejunum, employing a procedure ad modum Polya.

The following is the report of the pathologist from a gross specimen of the stomach. Specimen consists of the major portion of a stomach; it measures 25 cm. along the greater curvature and 9 cm. along the lesser. Specimen includes the pyloric ring and approximately 1.5 cm. of the duodenum. The outer surface bears a few fibrous and fatty tags on its posterior wall and there is attached a small amount of omentum and of the greater hepatic ligament. The serosa otherwise is smooth and glistening. The wall is well developed and when the organ is opened the mucosa is found to present somewhat unusually high, prominent folds throughout. The mucosa averages 1 mm. in thickness and beneath it there is a quantity of loose submucosa that, in the folds, attains a thickness of 1 cm. Immediately at the pylorus the mucosa is even more redundant than elsewhere and the pyloric ring consists of a well developed fold of mucus membrane 1 cm. high overlying a quantity of submucosa and a continuous muscular ridge 5 mm. in diameter. The loose mucosa at the pylorus can be slipped easily over the ring so as to cover entirely the portion of the duodenal mucosa. The mucosa of the latter is grossly normal.

Just proximal to the pyloric ring the posterior wall of the stomach near its mid-point presents a shallow linear defect that runs longitudinally a distance of 8 mm. and has a maximum width

of 2 mm. The edges of this are smoothly rounded and the base is made up of submucosa. There is no injection or hemorrhage about this defect, nor is there evidence of scarring. The opposite edges of the defect can be easily approached. Elsewhere the mucosa is intact; there are a few small bright red hemorrhages into it. The muscularis except for the hypertrophy of the pyloric ring, is only slightly heavier than normal, averaging 1.5 mm. in thickness.

Histologic findings are reported as follows: The mucosal architecture is regular and the glands are of the usual type, but here and there the superficial portion of a gland is dilated and is lined by high columnar epithelium of the intestinal type. Small papillary infoldings have been formed within several of these glands. The tunica propria is normal in amount but at many places there are dense infiltrations of lymphocytes, together with a few plasma cells and large mononuclear cells. At several points these infiltrations take the form of lymphoid follicles with ill defined germinal centers. Plasma cells predominate in one block from the pyloric region.

Two blocks taken through the linear defect noted just proximal to the pyloric opening show only a shallow V-shaped infolding of the mucosa, completely lined by glands. The glands here run somewhat irregularly and there is an increase of fibrous tissue in the tunica propria. It probably represents a healed erosion. The muscularis mucosae and the submucosa beneath it are normal.

Diagnosis: Chronic gastritis, redundant gastric mucosa, prolapse of gastric mucosa through pylorus and erosion of stomach, healed.

The patient tolerated the procedure very well; the postoperative course was uneventful. From the fourth postoperative day he was able to enjoy intake of fluids and diet by mouth, the diet being gradually increased and tolerated well. The patient was dismissed in good general condition on May 30, 1946. Following one month of further convalescence, he again signed aboard ship.

Etiology. In considering the origin of this condition one is at a disadvantage due to insufficient information regarding the actual pathologic picture present. True enough, in many of the reports pathologic investigations of the excised mucosal folds are presented. In others, such is lacking. In the two previous cases,[10] as well as in our present patient in whom partial gastric resection was performed, a diffuse chronic gastritis was noted. The presence of a chronic gastritis, however, has not been noted in some of the subjects with local excision of the mucosal folds. Reversely, we have had occasion to verify the absence of mucosal prolapse in cases of generalized hypertrophic gastritis of a most pronounced degree. Extrusion of antral gastric mucosa is not necessarily a characteristic part of the x-ray picture in that condition.

Eliasen and Wright,[4] in a discussion of the etiology of benign polyps of the stomach, have visioned a development from local mucosal hypertrophy to polyp formation as resulting from peristaltic action. The local hypertrophy would originate in a low grade mucosal inflammation due to physical, nutritional, functional, chemical or bacterial factors. According to this view, chronic gastritis in due time may lead to adenoma which may finally undergo malignant transformation.

In three operated patients Rees[6] mentions the finding of a constricted pyloric ring which, upon transection, appeared as a "white fibrous ring, both smaller and thinner than normal pyloric muscle and with no elasticity." He is of the opinion that this represents the primary pathologic condition and that, secondarily, hyperperistalsis of the stomach would lead to loosening of the mucosal attachment to the muscularis and finally to extrusion. Other investigators, however, have failed to note a similar pyloric muscle constriction. The significance of these observations, furthermore, seems uncertain in the absence of biopsy of the transected pyloric ring.

On the basis of normal anatomy of the various layers of the stomach wall as well as the physiologic peristaltic action of the gastric mucosa as well as the entire stomach wall, Scott[12] reasoned that "the structural conditions necessary for the development of a prolapse are inherent in the walls of the normal stomach. A prolapse occurs

only after the fibers in the flexible submucosa have been stretched and loosened by abnormal gastric peristalsis which, in turn, is initiated by neurogenic or chemical stimuli or a combination of both."

Symptomatology. A study of the reported histories in patients with extrusion of antral gastric mucosa gives one the impression of a diffuse type of dyspepsia. At least at present, on the basis of available information, it appears that there is no one symptom or grouping of symptoms or signs that may justify a definite clinical diagnosis without the aid of roentgenologic investigations.

Abdominal distress appears to be present in practically all of the subjects. Eructation, bloating and sensations of fullness after meals may be the only distress. In others may be noted intermittent episodes of cramp-like pain localized to the epigastrium or right upper abdominal quadrant, frequently aggravated by the intake of food, particularly heavy food. The intake of alkali is often found to be of little consequence. Several patients noted some benefit from soft or liquid diet. A considerable loss of weight is not uncommonly encountered.

In several of the patients a moderate gastric residue has been noted as determined by x-rays.[4,8,12] In no patient, however, can it be seen that gastric dilatation has occurred secondarily to complete pyloric obstruction resulting from prolapsed antral mucosa. Likewise, no case has been reported in which one can speak of a "gastric ileus" simulating the ball-valve syndrome caused by sudden invagination of a prolapsed polyp or neoplasm or foreign body, leading to a severe emergency condition requiring immediate surgical intervention.

Gastrointestinal bleeding is not a rare complication in these subjects.[5,7,8,12] Gastrointestinal bleeding may appear as intermittent occult blood in the stool only and may or may not be associated with secondary anemia. It may, however, present itself as acute episodes with profuse bleeding, resulting in collapse, as occurred in our patient. It is probable that bleeding arises from gastric mucosal erosions on a traumatic basis similar to those noted in certain cases of diaphragmatic hernia.

In our own patient, in whom partial gastric resection afforded full opportunity for close scrutiny of the removed part of the stomach, one was struck with the fact that an innocent appearing erosion was the only positive finding that could explain the previous recurrent, severe episodes of bleeding. Whether or not actual ulcerative processes may occur in the prolapsed mucosa remains uncertain. The ulcerations as described in one report[9] lose significance, as it appears from the operative as well as the pathologic report that one was dealing not with simple antral mucosa extrusion, but with a pedunculated fibroma projecting through the pylorus.

In this connection it may be pointed out that malignant degeneration in a true case of antral mucosal prolapse is as yet not reported. The frequent reference to such a possibility is based on a report[13] which, by closer study, proves to deal with a generalized gastric polyposis with malignant degeneration.

From what has been stated, it seems evident that extrusion of antral gastric mucosa must be considered in the differential diagnosis in patients with obscure episodes of gastrointestinal hemorrhage. Retrospectively, this has forcefully been brought to our mind when reviewing the history of one of our subjects observed in 1944.

Case II. The patient was a seaman, aged fifty-one years, who had been perfectly well up to the spring of 1944 when he was forced to go ashore because of increasing shortness of breath and weakness. There was no history of dyspepsia prior to the onset of this disease, nor did such appear to any great extent during the one and a half years he remained ashore before his repatriation to Norway at the end of the war. His only abdominal complaint was occasional epigastric fullness and eructations after meals. He was a moderately heavy drinker. Laboratory tests revealed a pronounced secondary

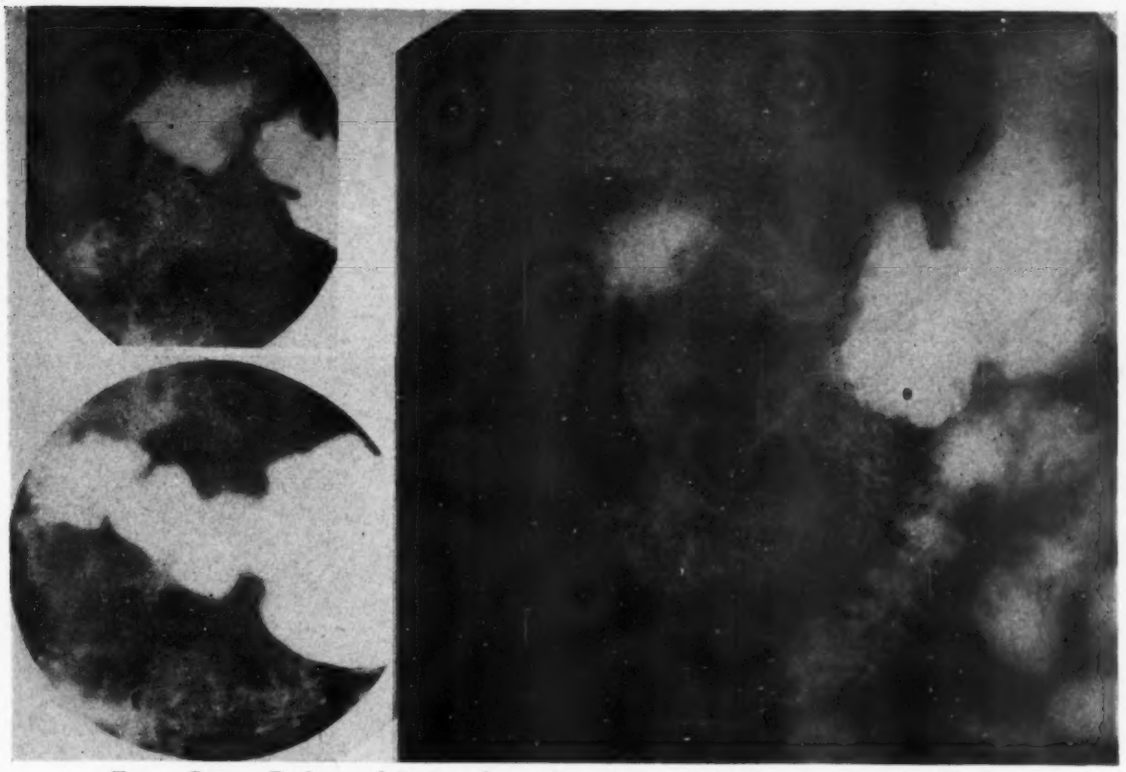


FIG. 4. Case II. Prolapse of the antral gastric mucosa into the base of the duodenal bulb.

anemia. Gastric acidity tests revealed values within normal limits for total and free hydrochloric acid. Repeated stool examinations at repeated intervals over a long period of time proved the constant presence of occult blood in the stool. During the time the patient remained under observation, an endless number of investigations accumulated and a series of consultations were held. On five different occasions a complete gastrointestinal investigation was performed by three different roentgenologists. No definite lead was ever secured as to the source of the occult blood in the stool. Over this period of one and a half years, the patient was given in all, eight blood transfusions in addition to intensive anti-anemic medication.

The patient was reluctant to accept the proposal of exploratory laparotomy as he "did not feel sick, only somewhat weak at times," when his hemoglobin fell below 60 per cent. Our own uncertainty as to the source of the bleeding as well as the uncertainty of detecting this by an exploratory laparotomy, admittedly did not constitute a too convincing basis for overcoming this intelligent patient's objection to an operation.

The case was taken up for review after we had operated upon the patient whose history is detailed earlier in this paper. This was several months after the repatriation of our patient. The review again brought out that hypertrophic gastritis had been reported in each of five gastrointestinal x-ray investigations. It was with no small chagrin that we then noted that in two of the x-ray series undertaken by one of the authors, Dr. Lewitan, a correct description had been given of a prolapsed gastric mucosa visible in the x-ray pictures of both series. (Fig. 4.) In spite of it being observed as well as reported, at the time we considered this merely a coincidental finding. Subsequent clinical experience indicates that in all probability we did grossly err in this assumption.

One cannot with absolute certainty, state that this review of the case identifies the extrusion of antral mucosa as the source of the bleeding, inasmuch as no operation was performed. This, however, does not change the following important practical point: With the roentgenologic demonstration of mucosal prolapse, coupled with a realization that this may give rise to a

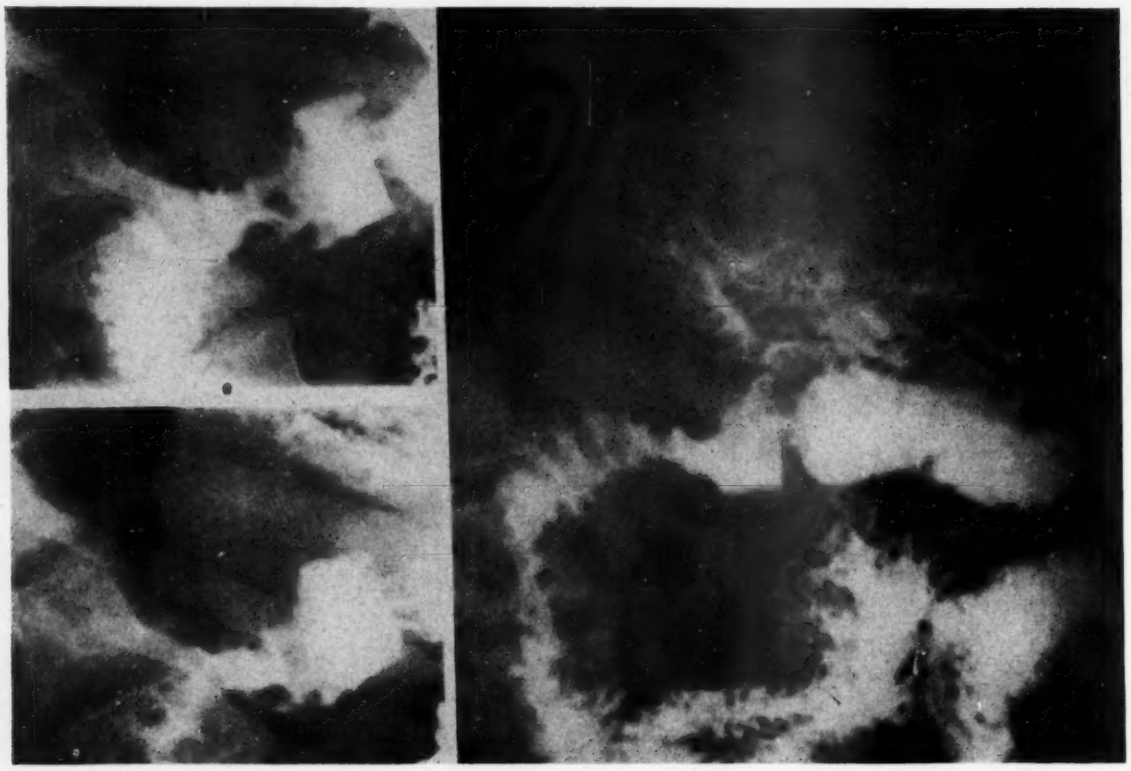


FIG. 5. The appearance in minimal prolapse; wide open pyloric canal and translucent defect with striations in the base of the bulb. At the apex of the defect there is scalloping.

gastrointestinal hemorrhage, a proposed surgical intervention would thereby have been given a definite diagnostic basis as well as an important cue for the surgical approach. We failed, not in the x-ray demonstration of the prolapse, but in the realization of the various clinical pictures that may arise from such a condition. The object lesson seems clear. The whole responsibility cannot be made to rest with the roentgenologic department only. Evaluation of the findings rests with the clinician.

In the x-ray examination of a suspected lesion of this kind, certain technical details have to be observed. Pendergrass and Andrews[5] stressed prone views as essential. The patients included in this report showed gastric mucosal folds in the duodenum in the erect as well as in prone positions. Overdistention of the stomach by a great amount of barium, however, would completely obscure the presenting pathologic symptoms as well as supine views. Compression or incomplete filling would bring the pathologic condition out most clearly. (Fig. 2.)

Radiographically, the following features are of diagnostic importance: A filling defect in the base of the bulb resembling a small cauliflower. The defect permits recognition of characteristic gastric folds by the presence of striations and scalloping. The gastric rugae in the duodenal bulb are continuous with the prepyloric folds. The defect changes its size and volume coincident with antral systole and diastole. The pylorus appears wide open and gastric emptying time is increased. There is usually an increase in the caliber of the gastric rugae and the presence of hypersecretions at the onset of examinations is also noted. (Figs. 5, 6 and 7.) Once the roentgenologist is trained to evaluate correctly the changing pattern of prolapsing redundant gastric mucosa, the diagnosis will be made more frequently. The demonstration of minimal prolapse may be looked upon as objective evidence of the presence of a gastritis, for which definite

diagnostic criteria roentgenologically are still lacking. A demonstration of the small prolapsing lesions in association with gastric ulcer is not surprising because of the frequent association of gastritis with gastric ulcer. (Fig. 8.)

Treatment. With our hypothetic understanding of the origin of antral mucosal extrusion at present, medical treatment necessarily will be essentially of a symptomatic character. As pointed out, cases are reported in which co-existence of gastritis was noted. When such a condition is noted to be present, however, medical treatment as for gastritis would be the logical approach. Definite improvement has been noted after a bland diet with frequent small meals. Antispasmodics suggest themselves in view of the irritability of the pyloric ring resulting from mechanical stimulation by the pendulating movements of the mucosal folds.

In some patients antacid medication has been of no avail; in others it has given intermittent relief. In a patient recently under our care, best results were obtained by a moderate dose of milk of magnesia at night. Occasionally, rest after meals is found comforting because of a slipping back of an extruded fold into the antrum. In general, no fast rules as to the medical regimen can be laid down. Each patient requires careful individual consideration.

A patient has asked us if medical treatment would ever result in retraction of the mucosal folds. At present we are not in a position to answer whether or not this condition represents a reversible process. One of our patients has been carried on a medical regimen for two years. Repeated roentgenologic examinations during this period, at least up to the present time, have given no indication of any essential changes in the x-ray demonstration of the mucosal extrusion. In this patient the subjective moderate distress has likewise been practically stationary although never severe enough to make him discontinue his regular activities as a mechanic In a few other subjects the observation time has been shorter. Our impression is that in none of these has there been any gradual progression of the degree of extrusion. In one of these patients the history of dyspepsia of the same character as at present dates back to 1937. With some justification, therefore, it appears that a progressive enlargement of the prolapsed mucosal folds does not necessarily take place. Whether or not the process is reversible must await further observations.

Fig. 6. The appearance of the prolapse in another of our patients at the first examination in 1944. With the patient erect the film shows the presence of hypersecretions which form a fluid level with the barium mixture.

As to the question of medical *versus* surgical treatment of this condition, the decision will rest upon an analysis of each individual patient.

Up to now, no case has been reported leading to acute gastric dilatation due to pyloric obstruction. On theoretic grounds only such a "ball-valve phenomenon,"

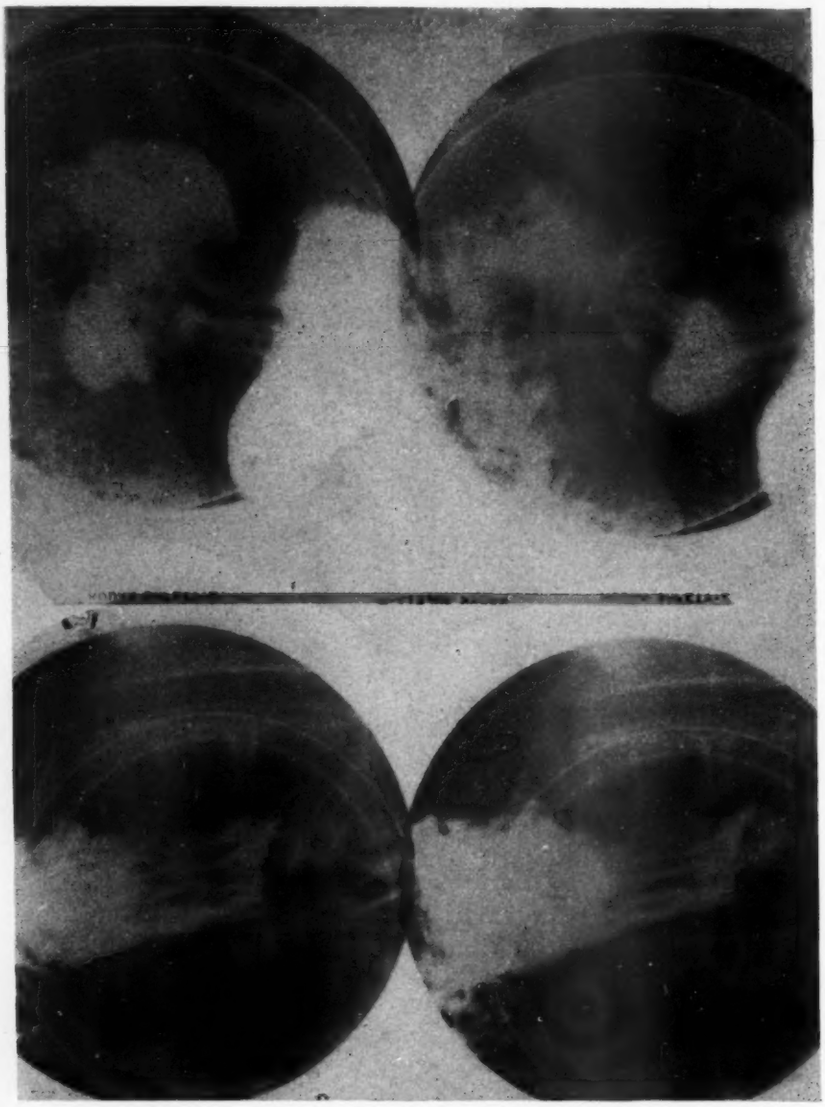


FIG. 7. Follow-up examination of the same patient two years later. Top films disclose the characteristic prolapse of the antral gastric folds into the base of the duodenal bulb. Lower films demonstrate the entirely normal mucosal pattern of the duodenal bulb. The prolapse is not seen in the latter views. The apparent inconstancy of the finding is characteristic of prolapsing lesions.

however, seems within the realm of possibility and may deserve consideration in the evaluation of some acute abdominal conditions. The sudden, profuse gastrointestinal hemorrhage, as observed in our patient, appears the only one of the entire series requiring emergency measures.

Since von Schmieden[2] in 1911 performed a gastrotomy with excision of the hypertrophic mucosal folds and employing a plastic operation to increase the outlet from the stomach, a similar principle has been followed by most of the subsequent operators. In most patients this likewise appears to have given satisfactory results.

It may be debatable whether or not such a procedure will prove entirely satisfactory in individuals with a history of bleeding. In reports of the three patients with associated hemorrhage, recurrence of bleeding followed excision of gastric folds and pyloroplasty.[5,8] With this uncertainty in mind we decided in our patient in favor of a partial gastric resection. Such a proce-

dure was employed in two other subjects in the entire series.[10] In the latter no history of gastrointestinal bleeding was elicited, but the presence of pronounced hyperacidity seemed to warrant the more extensive procedure.

Gastro-enterostomy probably has no place in the surgical treatment of this condition. It has been employed in two instances.[3,6] In one of these[6] a second operation had to be performed with excision of gastric folds and pyloroplasty. In the other patient, co-existence of a duodenal ulcer decided in favor of a gastro-enterostomy and with apparently satisfactory results.

In this connection the varying palpatory findings at the time of operation deserve consideration. In von Schmieden's report a clear description is given of a palpable tumor-like induration in the pyloric area. Similar observations were also made by others,[3,4,7–10] as well as noted in our patient. It seems, therefore, quite probable that the experienced surgeon during a routine exploration in certain patients would be able to put his finger on such an existing gastric pathologic condition even without preoperative positive roentgenologic exploration. It must be recalled, however, that in every one of the operative patients of this series the preoperative x-ray findings indicated the presence of at least abnormal conditions of the pyloric area, if not actual mucosal prolapse. Of greater significance is the statement in several of the reports that careful palpation alone of the antrum and pyloric area gave no confirmatory evidence of the preoperative x-ray findings. Verification of the existing pathologic disease was only obtained after opening into the stomach. In one patient[6] a regular exploratory laparotomy without gastrotomy failed to localize the existing pathologic condition. As the patient's distress continued subsequent x-ray investigations succeeded in demonstration of the mucosal prolapse. Subsequent reoperation with gastrotomy and excision of prolapsed mucosal folds finally resulted in cure.

It may further be of significance to point out the momentary variability of the palpatory findings during operation, as described herein. As a consequence, it will be readily appreciated that a complete and dependable preoperative roentgenologic report in these patients constitutes the essential guide for the surgeon in his decisions regarding problems confronting him during the actual operation.

Fig. 8. Pyloric ulcer associated with minimal secondary prolapse in another of our patients, a man aged thirty-two. At operation an ulcer the size of a dime was found on the posterior wall of the prepyloric region which had penetrated into the peripancreatic capsule. Partial gastric resection was followed by good therapeutic results.

SUMMARY

1. A review is presented of cases of transpyloric herniation of gastric mucosa. Personally observed patients are included; one of these underwent partial gastric resection because of repeated, severe gastrointestinal hemorrhages resulting from erosion of the extruded gastric mucosa.

2. Future closer attention to this condition will probably prove its presence in a considerably larger number of individuals than is apparent at present. With this in mind it is suggested as probably worth while to review the histories of patients with an indeterminate type of dyspepsia

previously classified as functional disorders. It is anticipated that some of the latter may present positive roentgen evidence of extrusion of redundant gastric mucosa through the pylorus.

3. Transpyloric herniation of the gastric mucosa represents a pathologic entity; it is essentially characterized by an abnormally loose layer of submucosa and redundancy of the antral gastric mucosa. Because of their anatomic position, these redundant mucosal folds are intermittently extruded through the pylorus into the duodenum. In many of the subjects a coexistence of hypertrophic gastritis has been noted. In others, it has been found to be absent. We have personally been impressed by the fact that several of the patients intermittently have been heavy consumers of alcoholic beverages.

4. At least with our present knowledge, the type of dyspepsia present in these patients is of such a diffuse uncharacteristic type as to prevent a definite clinical diagnosis without the aid of the roentgenologist. The very uncharacteristic, sometimes bizarre history, however, may make the clinician suspicious of such a condition and thereby alert the x-ray department to pay particular attention to the prepyloric and pyloric area during x-ray investigation.

5. The possibility of a mucosal erosion of the extruded gastric mucosa must be kept in mind as a differential diagnostic point in evaluation of patients with obscure types of gastrointestinal bleeding.

6. In most patients the roentgenologic picture of transpyloric herniation of the gastric mucosa is a typical one and is represented by a filling defect resembling a cauliflower. It is to be emphasized that, due to peristaltic movements of the individual mucosal folds, the outline of the defect may change its pattern from moment to moment. In order to permit accurate studies, certain technical details must be carefully considered, namely, change in position of the patient, change of views, adequate technic for mucosal studies, avoiding overdistention with contrast media and careful compression technic.

7. In the treatment of this condition it seems logical in most patients to try medical measures first (dietary regime, antispasmodics, correction of abnormal production of gastric juices). Striking improvements are usually not observed, but may be sufficient to allow the patient reasonable comfort and ability to work. In others, the severity of, or rapid progression of the distress particularly when associated with gastrointestinal bleeding, may necessitate surgical intervention.

8. It is of inestimable value to the surgeon preoperatively, to have obtained a correct and complete roentgenologic diagnosis as well as the clinician's careful evaluation of the entire clinical picture. This information represents valuable guidance during the actual exploration and will help him to decide whether or not to perform an exploratory gastrotomy and whether to select as the operative procedure an excision of the redundant folds with pyloroplasty or the more extensive gastric resection.

REFERENCES

1. Meyer, K. A. and Singer, H. A. Intermittent gastric ileus due to mechanical causes. *Surg., Gynec. & Obst.*, 53: 742, 1931.
2. von Schmieden, V. Die Differentialdiagnose zwischen Magengeschwür und Magenkrebs; die pathologische Anatomie dieser Erkrankung in Beziehung zu ihrer Darstellung im Røntgenbilde. *Arch. f. klin. Chir.*, 96: 253, 1911.
3. Eliason, E. L., Pendergrass, E. P. and Wright, V. W. M. The roentgen-ray diagnosis of pedunculated growths and gastric mucosa prolapsing through the pylorus: review of the literature. *Am. J. Roentgenol.*, 15: 295, 1926.
4. Eliasen, E. L. and Wright, V. W. M. Benign tumors of the stomach. *Surg., Gynec. & Obst.*, 41: 461, 1925.
5. Pendergrass, E. P. and Andrews, J. R. Prolapsing lesions of the gastric mucosa. *Am. J. Roentgenol.*, 34: 337, 1935.
6. Rees, C. E. Prolapse of the gastric mucosa through the pylorus: surgical treatment. *Surg., Gynec. & Obst.*, 64: 689, 1937.
7. Bohrer, J. V. and Copleman, B. Prolapsing redundant gastric mucosa: case report. *Radiology*, 31: 220, 1938.
8. Archer, V. W. and Cooper, G. Jr. Prolapse of the gastric mucosa. *South. M. J.*, 32: 252, 1939.

9. Melamed, A. and Hiller, R. I. Prolapsed gastric mucosa: roentgenologic demonstration of ulcer crater in prolapsed polypoid mucosa. *Am. J. Digest. Dis.*, 10: 93, 1943.
10. Norgore, M. and Schuler, I. J. D. Extrusion of gastric mucosa through the pylorus. Report of two patients treated by partial gastrectomy. *Surgery*, 18: 452, 1945.
11. Eusterman, G. B. and Balfour, D. C. The Stomach and Duodenum. Philadelphia, 1935. W. B. Saunders and Co.
12. Scott, W. G. Radiographic diagnosis of prolapsed redundant gastric mucosa into the duodenum, with remarks on the clinical significance and treatment. *Radiology*, 46: 547, 1946.
13. Rubin, J. S. Prolapse of polypoid gastric mucosa into the duodenum, with malignant change. *Radiology*, 38: 362, 1942.

A muscle hernia is easily distinguished from varicose veins by the fact that it protrudes when the patient is standing and becomes even larger when he is standing on his toes. It is less prominent when the patient is not on his feet or when he is standing with the foot dorsiflexed, at which time the protrusion may disappear entirely.

From "Surgery of the Ambulatory Patient" by L. Kraeer Fergerson (J. B. Lippincott Company).

REPAIR OF MASSIVE DEFECT OF TIBIA WITHOUT FIXATION*

LIEUT. COL. PETER CYRUS RIZZO, M.C.† AND CAPT. OTTO LEHMANN, M.C.
Army of the United States
Cambridge, Ohio

A PROCEDURE used by the authors in the treatment of large bony loss of the tibia is offered. This method differs from others in that no metallic or other form of foreign substance is used to maintain position of donor graft. An almost similar treatment has been used in 200 cases of non-union. The number of cases now being presented are six with 100 per cent success.

We believe that when foreign material is introduced into a healed compound wound the incidences of flare-up and latent infection are imminent. This opinion is gained from experience in patients treated by us with metallic fixation. Of eight patients so treated four needed secondary surgery.

Our experience has shown us that any fixation of the graft with metals or other foreign materials is not necessary provided the site for reception is well prepared. This opinion is substantiated by the results found in the treatment of fractures by the closed method. It can be said with reasonable certainty that most fractures heal, whether comminuted or simple, provided there is good contact of fragments. The greater number of patients are treated by the general practitioner. His experience might be extensive and it might be very meager; nonetheless, in the uncomplicated case he usually gets a good result. Immobilization of these fractures by the general practitioner is accomplished by cast, splints

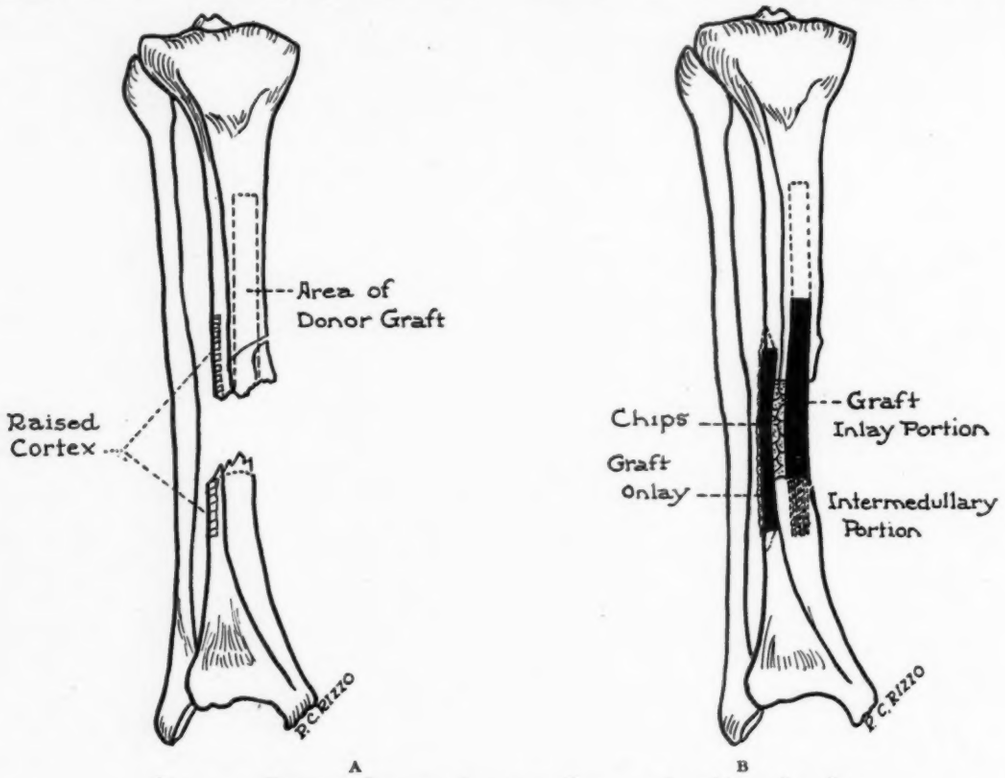


FIG. 1. A, diagram of prepared area; B, diagram of position of grafts.

* From Fletcher General Hospital, Cambridge, Ohio.
† Dr. Rizzo is now in practice in New York City.

A B

FIG. 2. Case R. M. A, preoperative x-ray; B, four months postoperatively showing outlines of grafts and healing process.

A B

FIG. 3. Case N. P. A, preoperative x-ray; B, five months postoperatively showing incorporation of grafts and solid healing.

and suspension apparatus. The casts vary from snug skin plasters with excellent immobilization to the thickly and overpadded cast with plenty of room for movement inside the cast as soon as the swelling subsides and the padding becomes compressed.

In some instances splints have been used and most of these are inadequate. Suspension treatment by weights cannot give absolute fixation since the patient is always jiggling about and there is a varying degree of motion at the fracture site. Figures 1A and B describe graphically the procedure we use.

All fibrous tissue is removed from between the fracture ends and as much scar tissue as possible from the surrounding structures. The medullary canal is opened

and all fragments of sclerotic bone removed. Next a donor graft is taken from the longer of the tibial fragments. The longer the graft the more useful it is. The lateral or medial aspect of the tibia is exposed and a thin layer of cortical bone is raised in both fragments. This is to be the recipient surface for one of the donor grafts. Meanwhile a graft has been removed from the opposite leg, usually one measuring 6 to 7 inches by ⅝ to ¾ inch. This graft is inserted into the medullary canal of the shorter fragment and inlaid into the space created by the removal of the donor graft from the larger fragment. The other donor graft, the one removed from the same tibia, is placed in the prepared area on the lateral or medial aspect of the tibia; it is an onlay graft in nature.

Next, bone chips are placed in the space between the two grafts. These chips are usually trimmings from the grafts. The free graft "onlay" is covered and held in place by the leg muscles when the tissue is closed in layers. A long leg plaster is next applied. This is to be changed in six to eight weeks when an unpadded plaster cast is applied. This unpadded plaster cast is used as a walking plaster by attaching a walking iron eight weeks postoperatively. The patient is kept in a walking plaster for four to five months. Check-up monthly x-rays determine the duration of immobilization. A brace is worn for two to four months after this. The duration is again determined by check-up x-ray.

The procedure herein described can be called a combination of onlay, inlay and intramedullary graft. Figures 2 and 3 demonstrate the before and after results in following two cases:

CASE REPORTS

Case I. R. M. sustained a compound comminuted fracture of the right tibia and fibula on December 3, 1944. Prior to admission to Fletcher General Hospital he had undergone débridement and secondary closure. On arrival his leg was in a long cast. There was complete healing at the site of injury. X-rays showed absence of about 2 inches of the tibia at the middle third. On April 21, 1945, a double bone graft was performed. The cast was removed October 10, 1945. He then wore a brace until December 3, 1945, and was subsequently discharged with firm union.

Case II. N. P. was wounded in action on November 19, 1944. On admission to this hospital the leg was well healed but x-rays showed loss of about 2 inches of the upper third of the tibia. On April 7, 1945, fusion of the fibula to tibia was done distally and proximally; on June 28, 1945, an osteotomy of the fibula and double bone graft was performed. After five months the cast was removed. Union was so firm that no brace was necessary and he was discharged healed on January 28, 1946.

RISK AND WELL PLANNED SURGERY

W. M. JOHNSTON, M.D.
Akron, Ohio

THE question is often asked by laymen, "I wonder if I will be able to stand the operation." Unfortunately, we often find that some medical men treat definite surgical pathologic conditions too long, with the excuse that, "it may save you from an operation." Actually, there are few men in the profession who really believe that such a hazard exists in a major operative procedure that it is perhaps best to treat them with a non-surgical method and that their expectancy of life may be prolonged thereby. Perhaps it was only twenty-five years ago that this was true. In days before that we know it was true.

Today, with all our modern preparations and study, both preoperative and postoperative, with modern anesthesia and technic, nearly any surgical procedure which may be indicated can be carried out successfully regardless of age or condition of the patient.

I believe that any patient with normal heart, lungs and kidneys on which a major surgical procedure is carried out should have 100 per cent recovery, unless some unforeseen accident occurs, if all adequate study and preoperative care, surgical judgment and postoperative care are judiciously employed. We cannot say we have solved surgical problems until we can guarantee such a percentage of recoveries.

We submit a brief record of a fifty-two year old female patient who had nine operations in twenty-five years, eight of them major, by six different surgeons and in all of which definite pathologic disease was shown. In spite of this trouble she has been able to carry out the duties of a normal wife and mother.

CASE REPORT

This patient was first admitted to Mercy Hospital, Columbus, Ohio in September, 1921 on the service of Dr. Joseph Price with the usual history and symptoms of chronic salpingitis. This was long before the days of penicillin, therefore surgical treatment was carried out. A bilateral salpingectomy, left oophorectomy and incidental appendectomy were performed under general anesthesia.

The pathologic diagnosis was chronic salpingitis and hemorrhagic cyst of the ovary. The patient made an excellent recovery from this surgical procedure.

Admission number two was to Mt. Carmel Hospital, Columbus, Ohio, on the service of Dr. Charles Hamilton. This was for severe thyrotoxicosis. The patient's condition was so critical that only bilateral ligation of the thyroid arteries could be performed. After this procedure the patient was discharged and requested to return in a few weeks for thyroidectomy. She stated that she "felt so good" after the operation that she did not desire any further surgery. However, her thyroid condition became so severe soon after a change in her residence that she was compelled to enter the hospital a third time.

This was at Gadsen, Alabama, where a thyroidectomy was performed under local anesthesia in February, 1928, by Dr. Lorage of Gadsen. Again the patient made a good surgical recovery although she must have had a great heart strain as an exophthalmos of some extent still persists.

A fourth admission, and the first one to be entered at the Akron City Hospital, was on November 27, 1931, on the service of Dr. C. E. Jelm with a diagnosis of hydronephrosis of the left kidney, which was confirmed by cystoscopic examination. Surgical operation to free a pelvoureteral junction adhesion was performed under spinal anesthesia. Adhesions, which produced constriction of the ureter and the pelvo junctions, were freed. The patient recovered quickly and was freed of her hydronephrosis and of her symptoms.

The patient's fifth surgical admission and the first under the author's service was to the Akron City Hospital on June 1, 1934.

At that time she had the history and physical findings of an acute intestinal obstruction. At an emergency operation under spinal anesthesia we found an acute obstruction caused by about 3 inches of ileum which had become adherent to her remaining and now cystic right ovary. This evidently was a chronic adhesion which had become acute. The ileum had to be dissected from the ovary, multiple fibroid tumors of the uterus were noted but no further surgery was indicated at this time because of the toxic condition of the patient due to intestinal obstruction. Again the patient made a good recovery with the proper postoperative treatment of this chronic and acute complication of intestinal obstruction.

The pathologic findings which we discovered at the time of this admission increased and caused the sixth hospital admission of this patient again at the Akron City Hospital and again under the author's service in March, 1937. On April 1, 1937, we did a supracervical hysterectomy and an oophorectomy on this patient under spinal anesthesia.

The pathologic diagnosis of the material submitted was multiple intramural and subserous fibromyoma of the uterus and large hemorrhagic cyst of the ovary. Once again the patient made a quick recovery from this operation and returned home ten days postoperatively.

Approximately one year later in April, 1938, this patient was again admitted to the same hospital under my service with a history and complaint of service attacks of pain in the left kidney region, the same kidney on which the previous operation of the pelvoureter junction had been performed seven and one-half years previous. X-ray examination showed a large left hydronephrosis with multiple calculi and complete blockage of the ureter. The kidney was non-functioning. On this seventh admission, therefore, we were obliged to perform a left nephrectomy which we did under spinal anesthesia.

The pathologic diagnosis stated left hydronephrosis with marked dilation of the calyces and fibrous atrophy of the cortex. There were five stones up to 3 cm. in diameter. Once again the patient made an excellent surgical recovery and left the hospital thirteen days postoperatively.

While the author was absent during the recent war, this patient had admission and operation number eight. Her complaint at this time was pain in the right upper quadrant and back. She was admitted to the service of an experienced urologist. In a careful review of all these admissions this was the only one about which there may have been a question as to the indication for surgical procedure. A diagnosis of ptosis with one plus hydronephrosis of the right and only remaining kidney was made and right nephropexy under general anesthesia was performed on September 15, 1942.

In my opinion a nephropexy is one operation that should be discarded as a relic of the past. The patient made a good surgical recovery from this procedure and left the hospital on the thirteenth day postoperatively.

Upon my return from military service this patient again came to me with a complaint similar to the one that caused her eighth and last admission. This was in September, 1945. History and physical examinations convinced me that this patient was now and probably had been for some time suffering from gallbladder disease. This was demonstrated by x-ray examinations.

Therefore, the patient was admitted to the hospital for the ninth time. We performed a chloecystectomy, again under spinal anesthesia which the patient tolerated with great ease. The pathologic diagnosis was cholecystitis with lithiasis. The gallbladder contained twenty-four large calculi. Once again this patient made an excellent recovery and was home on the thirteenth postoperative day.

We saw her recently, one year after her last operation, and she appears to be in excellent health with no complaints whatsoever.

CONCLUSION

We have presented the history of a patient on whom nine separate surgical operations by six different surgeons have been performed with definite pathologic disease in each instance. I believe that with careful study, careful diagnosis, good preoperative preparation, accurate surgery, good anesthesia, (spinal preferred) and good postoperative care of the patient, surgery can almost reach the "wonder stage" of relieving pain and extending life.

CHORIONCARCINOMA

PAUL PERNWORTH, M.D.
Attending Surgeon, St. Elizabeths Hospital, Granite City, Ill.
Venice, Illinois

BECAUSE malignant tumors involving fetal parts are infrequently seen during the course of general surgical practice and as their symptomatology is relatively obscure, this type of malignancy is often unsuspected until generalized metastases have occurred.

In 1943, we had the opportunity to treat a patient giving a clinical history of abnormal uterine bleeding of fourteen months' duration. Pathologic examination of the operative specimen revealed an invasive chorioncarcinoma. Statistics indicate that this is an uncommon condition with an incidence of about 0.01 per cent or one in each ten thousand cases of uterine tumors.

Clinical Features and Pathology. Chorioncarcinoma in the female is always associated with pregnancy. It may follow an abortion, more rarely a full term pregnancy and is seen in one-third of patients with a hydatidiform mole. In the male it appears as a testicular tumor probably as the result of embryonic ectodermal inclusions. The interval between gestation and the appearance of the chorioncarcinoma may be as long as three years although generally it is much less. Associated with this tumor is a high incidence of large, bilateral lutein cysts of the ovaries probably a result of rather than a cause for the uterine condition.

For many years the tumor was believed to be of decidual origin because of the similar histologic picture but Marchand established the currently accepted view that it, like the hydatidiform mole, is of fetal origin arising from chorionic villi. The essential unit of the villus is the trophoblast, composed of an outer layer of dark, multinucleated cytoplasmic masses known as syncytial cells, and an inner stratum of large, clear, cubical cells with poorly staining nuclei called Langhans' cells. The purpose of the trophoblast under normal conditions, i.e., pregnancy, is invasion of uterine blood vessels for the formation of an adequate fetal circulation. The malignant activity of chorioncarcinoma which retains trophoblastic characteristics is expressed by it's invasion of venous and arterial sinusoids. Cellular emboli are rapidly and profusely disseminated to distant parts of the body even early in the disease. Usual sites of metastases are the lungs, brain and vagina. The associated poor prognosis is attributable to this metastatic potentiality and the unusually high degree of cellular anaplasia. There is no stroma or blood vessels, the tumor receiving nourishment from the vessels it invades. Microscopic sections show a diffuse hyperplasia of the Langhans' cells with penetration through the syncytial layer into the uterine musculature. It is the Langhans' layer that is the culprit. Cases have been reported of patients harboring chorionepithelioma which exhibited no metastatic tendencies. These were probably examples of syncytiomas or benign trophoblastic tumors composed of predominantly syncytial elements having no invasive characteristics. In this type of tumor the Langhans' cells are conspicuously absent.

Clinically, the tests of pregnancy, depending on the presence of ovarian-stimulating pituitary hormones, are positive in all cases of chorionepithelioma. The Aschheim-Zondek test may therefore be used as an index of existing trophoblastic activity in diagnosis and for determining the completeness of surgical extirpation. Strongly positive Aschheim-Zondek tests are also produced by chorionepithelioma in the male.

Diagnosis. The primary malignancy is usually small and may be unaccompanied by any appreciable uterine enlargement so that eliciting a history of past pregnancy is extremely important. Earlier expulsion of a mole is very significant. Repeated uterine hemorrhage with the appearance of a positive Aschheim-Zondek reaction or increase in the strength of a previously positive test suggest the presence of chorionepithelioma. A *gentle* curettage is indicated and the specimen obtained should be subjected to careful microscopic examination. Curettement of patients with a hydatidiform mole or chorioncarcinoma is not without danger as the thin, weakened uterine wall can be easily perforated even by a dull curet or the finger.

Treatment. In patients with generalized metastases or with parametrial infiltration due to chorioncarcinoma, surgery is useless. Radiation therapy may be circumspectly instituted but the prognosis is uniformly poor. Chorioncarcinoma is among the most malignant of tumors. When the lesions are confined to excisable areas, hysterectomy is the treatment of choice. Postoperative gonadotrophic hormone assays should be repeated to determine the completeness of surgical removal.

CASE HISTORY

Mrs. G. P., No. 322043, was admitted to St. Elizabeth Hospital on September 20, 1943, with a chief complaint of continuous vaginal bleeding of fourteen months' duration. She stated that in 1942, following a normal obstetrical delivery, a slowly, progressive loss of strength and energy developed. She did not feel well and the postpartum lochia remained blood-tinged. Six weeks later, there was a sudden, profuse vaginal hemorrhage accompanied by the passage of large clots, lasting about one hour. Medical treatment, administered elsewhere, consisted of progesterone injections which diminished the bleeding but failed to produce complete cessation. Metrorrhagia continued for one year, varying daily in amount from a slight bloody show to episodes of severe active bleeding necessitating bed rest and sedatives. The patient had lost 25 pounds in weight; there had been no pain or nausea.

Physical examination disclosed a pale, thin female, aged thirty-one years, showing marked air hunger. The head was normal except for slight exophthalmus. The thyroid was palpable and soft with no masses present. Superficial arterial pulsations were prominently visible in the neck, temporal regions, axillae and groin. The lung fields were tympanitic with no adventitious sounds. The area of superficial cardiac dullness seemed slightly enlarged to the left. The apical rate was 102 per minute, regular, with fair valve tones and no pulse deficit or murmurs. The blood pressure was 104/60 and the temperature, 99.6°F. The liver appeared normal in size and slightly ptosed; the right kidney could be palpated. The abdomen was scaphoid and showed evidence of substantial weight loss. There was a large umbilical hernia with diastasis recti probably caused by four past gestations. Abdominal tenderness was absent. Examination of the vaginal introitus disclosed a steady, sanguineous oozing through a clean multiparous cervix. A moderate degree of bladder prolapse and a large rectocele were present. The urethral sphincter tone was fairly good. Bimanual examination of the pelvis revealed a hypertrophied mobile uterus in second procidentia. The broad ligament and adnexa were normal with some suggestion of bilateral ovarian enlargement. In view of these findings, it was considered advisable to eliminate the possibility of fundal carcinoma and a gentle curettage was performed under local anesthesia.

The pathologic report indicated that the "Sections show tissue suggestive of chorioncarcinoma." The Friedman test, with blood serum obtained on the day after curettement, was strongly positive. Visualization of the vaginal mucosa under magnification failed to disclose the presence of malignant implants.

The blood serology revealed the following: white blood cells, 9,000; red blood cells, 3.1 million; hemoglobin, 53 per cent; stabs, 5; segmented, 58; eosinophiles, 1 per cent; lymphocytes, 29 per cent; monocytes, 7 per cent. Urine (catheter specimen), negative; blood group, A and Kahn test, negative.

Diagnosis: Chorioncarcinoma; umbilical hernia; uterine procidentia; cystocele-rectocele and secondary anemia.

On September 22nd, after a blood transfusion of 800 cc., the abdomen was explored through

an infra-umbilical, muscle-splitting incision under pontocaine spinal anesthesia. The uterus appeared grossly normal except for its position which was one of extreme retroversion. The ovaries were both congested, containing multiple follicular and lutein cysts but, in view of the patient's age, it was considered advisable to retain any normally functioning ovarian tissue if possible. The round ligaments were tied with silk and cut on each side, extending the incision from side-to-side through the vesicouterine fold of peritoneum. The bladder was then completely mobilized facilitating careful palpation of the broad ligaments down to the cervix for evidence of possible malignant infiltration. The tissues were soft and flexible. Both uterine arteries were ligated close to their origin and the uterus removed almost in its entirety leaving only a narrow rim of cervical tissue. Suspension of the cervix and vagina was accomplished by fixation to the broad and round ligaments. The bladder was sutured deep behind the cervical stump in an attempt to improve the existing cystocele. Both ovaries were subtotally resected allowing only grossly normal strips of tissue 1 by 3 cm. to remain on each side. These were peritonealized by a Poole suspension. The umbilical hernia was repaired from the peritoneal side by three silk mattress sutures and the abdominal layers approximated in the conventional manner with interrupted No. 40 cotton. The patient was then placed in lithotomy position for repair of the rectocele. It was noted that the intra-abdominal bladder advance had favorably influenced the cystocele, leaving only a moderate redundancy of anterior vaginal mucous membrane.

The pathologic report revealed the following: The specimen consists of a uterus 60 mm. long by 58 mm. at its widest diameter. This contains a necrotic mass roughly 40 mm. in diameter. It has some gross characteristics of placenta although it seems to be firmly attached to the uterine wall. Sections "show that there are synctial and Langhans' cells which have invaded the uterine musculature. This together with the ovarian cysts makes one think of a true malignancy rather than a burrowing mole. Would suggest running repeated pregnancy tests."

Postoperative convalescence was uneventful. An additional 500 cc. of citrated blood was administered on the day following operation and the Friedman test two days later was negative. A 6 foot chest plate, for possible metastases, was normal. The patient was discharged on September 3rd, the twelfth postoperative day. Three years later, she is in excellent health, two interim pregnancy tests were negative and the patient, we believe, may be considered to have had a complete removal of the chorioncarcinoma.

REFERENCES

1. Crossen, H. S. Diseases of Women. St. Louis, 1932. C. V. Mosby Co.
2. Wharton, L. R. Gynecology. Philadelphia, 1943. W. B. Saunders Co.

TRAUMATIC RUPTURE OF THE THYROID GLAND*

H. Mortimer Bishop, M.D. and Donald C. Durman, M.D.

Saginaw, Michigan

THIS case is reported because of its rarity.

CASE REPORT

K. K., a male aged forty-six, was admitted to the Saginaw General Hospital at 11 P.M. December 22, 1946. He was the driver of an automobile which skidded on icy pavement and crashed into a telephone pole. Two other occupants of the car were injured, one sustaining comminuted fractures of the femora and some lacerations about the face. The other had comminuted fractures of the right tibia and fibula, contusions of the face and a fracture of the nose. The patient K. K. was found to have a fracture of the right patella and a small abrasion of the neck over the right sternomastoid muscle. No evidence of other injuries were noted on admission. There was no shock. The fractured patella was temporarily immobilized by the use of a Cabot posterior splint.

About four hours after admission it was reported that the patient was having difficulty breathing and that there was some swelling of his neck. Ice packs were applied to his neck and a sedative was administered. His breathing gradually became more difficult. He was unable to be comfortable except in a sitting position. Several hours after the onset of orthopnea, the neck was found to be moderately and uniformly swollen, anteriorly. It was firm and tender. While the patient's breathing was difficult, his color was good and his pulse was normal. Examination by an otolaryngologist revealed that the air passages were free. There was no evidence of any compression or displacement of the larynx or trachea. It was believed at that time that there was some hemorrhage under the deep cervical fascia but that conservative treatment was indicated.

Orthopnea increased in severity but at no time was there any cyanosis. About noon on the day following admission, the difficulty in breathing and swelling of the neck had increased to such an extent that it was believed that hemorrhage under the deep cervical fascia was continuing and that surgical intervention was indicated. Swelling of the neck was uniform. All the landmarks were obliterated. The swollen area was of stony hardness to the touch and extremely tender. At 3 P.M. that afternoon an operation was performed. A transverse collar incision was made stripping the skin upward. The skin and platysma were found to be very edematous. The cervical fascia was divided in the midline and a large amount of clot and fluid blood allowed to escape from both sides of the trachea. There appeared to be a complete severance of the thyroid gland at the point at which the isthmus merged into the left lateral lobe. This looked as though it had been cut with a blunt instrument. The isthmus contained apparently some small adenomatous changes in which there were a number of blood vessels of a fairly large caliber. One of these presented an arterial bleed. This was ligated. The torn edges of the gland were approximated loosely with silk. The left side, from which there appeared to be some minor oozing, was packed lightly with iodoform gauze and the wound was closed loosely about this pack with interrupted sutures of silk.

As soon as the blood clot was evacuated, the patient took a long deep breath without difficulty. Convalescence was uneventful. The drain was removed on the second day and the wound healed by first intention.

Ten days later, operative repair of the fractured patella was done. The patient was discharged from the hospital on January 9th and he returned to work as a mechanic on February 18th. At that time he had no residual symptoms whatever suggesting any permanent damage to his thyroid. The range of motion of his knee was normal.

* From the General Surgical and Orthopedic Divisions of the Surgical Service of Saginaw General Hospital, Saginaw, Mich.

Comment. The character of the injuries of all three patients involved in this accident suggested that they had been violently thrown forward in the car. The exact mechanism of this patient's injury was not determined. He could not recall striking his neck against the steering wheel or any part of the car. At the time of the accident he was wearing a heavy overcoat and a sweater, both of which were pulled well up around his neck. It is presumed that he probably struck the right side of his neck against the steering wheel of the car.

HYPERTHYROIDISM results from an excessive absorption of the thyroid secretion (*thyroxin*) and is characterized by the stimulation of nearly every bodily function. A toxic goiter is one characterized by hyperthyroidism, or in the case of a diffuse toxic goiter with exophthalmos, possibly a toxic dysthyroidism.

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea & Febiger).

New Instrument

NEW TYPE APPARATUS FOR GIVING INTRAVENOUS ANESTHESIA

ALVIN Y. WELLS, M.D.
Winfield, Kansas

SEVERAL intravenous apparatuses have been described in the literature but none have offered the completely closed system with the compactness, ease of operation and control as the one herein described.

While the author was acting as anesthestist during the war, he developed the apparatus herein described. It has been used over a period of three years and has been found very satisfactory. Pentothal sodium was the drug used in every instance.

The apparatus* as shown in Figure 1 is essentially an instrument of simple construction which is a very great aid in administering intravenous pentothal sodium anesthesia.

The body (R) is made of cast aluminum and clamped flat on the arm board by means of a bracket (S) which is also constructed to hold the reservoir bottle (F). It is distinctive in its simplicity and compactness, being so small that it does not project up into the way of any of the operating equipment. Furthermore, the feeder screw (A) which operates through the sliding plunger head holder (D) gives more accurate control of the syringe plunger (E) with less friction. The rotary type syringe barrel clamps (J) are efficient and easily operated.

The bracket which clamps the apparatus to the table is so constructed that it may easily be transferred to the opposite side by merely loosening a thumb screw (Q). Since the bracket also holds the reservoir container the latter may be put on the side where it will be most convenient.

The accessory equipment consists of a small wide mouthed bottle (F) 2 inches in diameter and 2½ to 3 inches high, two 8-inch pieces of ⅛-inch inside bore rubber tubing (L), one three-way valve (K), a rubber stopper (G) containing two holes, one small glass observation needle adapter (N), one 20 cc. Becton, Dickinson syringe (I), a 20-gauge 1½-inch hypodermic needle (M) and two pieces of glass tubing connected with the stopper.

A stand is provided so that the apparatus may be assembled, the syringe, tubing and bottle filled with pentothal solution and all set aside conveniently until the anesthetist is ready to start anesthesia.

When the entire apparatus is set up as shown in Figure 1 and connected with the vein in the arm, it occupies so little space that sterile operating sheets may be thrown over it all. Operation of the equipment beneath the sheets is very easy and a measure of safety to both surgeon and anesthetist is added.

TECHNIC

The tubing with three-way valve and glass adapter, two 20 cc. syringes, two drug glasses, two 20-gauge 1½-inch needles, the reservoir bottle (with the rubber stopper) and some gauze sponges are wrapped and sterilized in an individual kit. The syringe plungers are coated with a little glycerine

* The apparatus is manufactured and distributed by the Kansas City Assemblage Company, Kansas City, Mo.

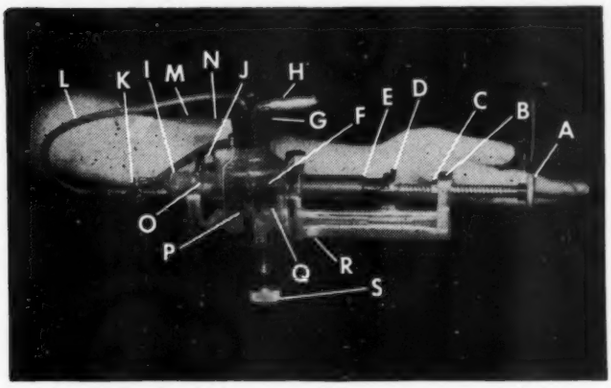


FIG. 1. A, feeder screw; B, set screw; C, I. D. threaded bushing; D, syringe plunger head holder; E, syringe plunger; F, reservoir bottle; G, rubber stopper; H, air vent tube; I, syringe barrel; J, rotary syringe clamp; K, three-way valve; L, rubber tube from syringe to supply bottle; M, hypodermic needle; N, glass adapter; O, holder for needle and tube when not in use. (The other cut opposite side of apparatus.) P, sliding arm of bracket. (The other cut opposite side of apparatus.) Q, thumb set screw to hold bracket in place. (The other cut opposite side of apparatus.) R, main body of holder; S, bracket for holding bottle and also for clamping apparatus to table.

before sterilizing. The syringe should be tested in the holder to be sure it fits before sterilizing.

When it is desired to give an intravenous anesthetic, the apparatus is assembled after checking all parts carefully. It is especially important to manipulate the three-way valve several times to be sure it works easily. Otherwise, the shank of the syringe may be broken off in the process. The Becton, Dickinson Luer-lok type syringe is safer to use and is included in the set.

Next, the pentothal powder is put into the medicine glass and sufficient sterilized distilled water (40 cc. per Gm.) added to make a 2½ per cent solution. When completely dissolved, the syringe and tubing are filled with solution, being sure to eliminate all air bubbles. The excess solution is put into the reservoir bottle and the stopper snugly applied. The reservoir bottle is fitted with a No. 6 stopper containing two holes. In one hole a glass tube connects the rubber tubing and syringe to the bottom of the jar for delivering the reserve supply of anesthetic solution. Into the other hole of the stopper a glass tube is placed to act as an air vent (H). In the latter tube is an enlarged chamber into which is placed some cotton to filter the air going to and from the jar.

When the unit has been assembled and filled with anesthetic solution, the syringe and bottle are fitted into the apparatus for clamping on the table. An alcohol sponge may be put on the needle before putting it into the clamp (O) on the apparatus. The entire apparatus is now set aside on the stand until the anesthetist is ready to start anesthesia.

When ready to start the anesthesia, the anesthetist clamps the apparatus on the armboard beside the patient's arm; the needle is inserted through the skin and the feeder screw reversed one-fourth turn to produce a back pressure so that the blood will immediately appear in the glass adapter as the needle punctures the vein.

The latter procedure will obviate the use of a syringe until the vein is found as is necessary in some obese patients. In fact, this works better than a syringe because the back pressure is maintained until the vein is punctured. This is a great advantage over other methods.

The anesthetic material is now injected slowly into the vein until the desired amount is given. A slight turn of the feeder screw may be made at intervals, if necessary, to keep blood from coagulating in the needle. When the patient is at the desired depth of anesthesia, the anesthetist's hands will be free to do other things. It is a great advantage to the anesthetist to have perfect control of the anesthesia and at the same time to be free to work with the patient at all times.

When the syringe is empty, one may change the three-way valve and reverse the feeder screw to refill from the jar. The valve is again changed and the anesthetic solution forced into the vein by a few turns of the feeder screw as needed. If the plunger seems to stick, give it a turn with the fingers and smooth operation will follow. However, "jiggling" the feeder screw back and forth slightly may be all that is needed.

The reservoir will hold enough solution for two or three patients and by merely changing the needle and tubing that delivers the pentothal from the syringe to the vein, one may give several anesthetics with perfect safety. Additional pentothal solution may be added to the reservoir bottle whenever desired.

If, at times, one does not wish to use the feeder screw, it may be left in the extreme distal position and the syringe plunger manipulated with the fingers. The apparatus still will be found useful to hold the syringe and its supply of pentothal solution.

Since some things made of glass vary considerably in their dimensions, it is sometimes helpful to turn the syringe in the apparatus to find the position that will give the smoothest operation. The apparatus is made to take a standard Becton, Dickinson 20 cc. syringe although others may be used.

It is believed that if one will familiarize himself with the mechanisms and use the apparatus a few times, he will not care to give intravenous pentothal without it.

SUMMARY

1. A new type apparatus for administering intravenous anesthesia is described.

2. The apparatus is compact, easy to operate and provides a safe means of giving intravenous pentothal sodium.

3. The administration of the anesthetic is completely under control at all times.

Pardon our stiff necks —

But it pays off in <u>safer</u> SAFTIFLASK SOLUTIONS

You couldn't find a more skeptical bunch of technicians than Cutter's testing staff. Always going around flexing their vocal muscles, saying *"Show me!"*

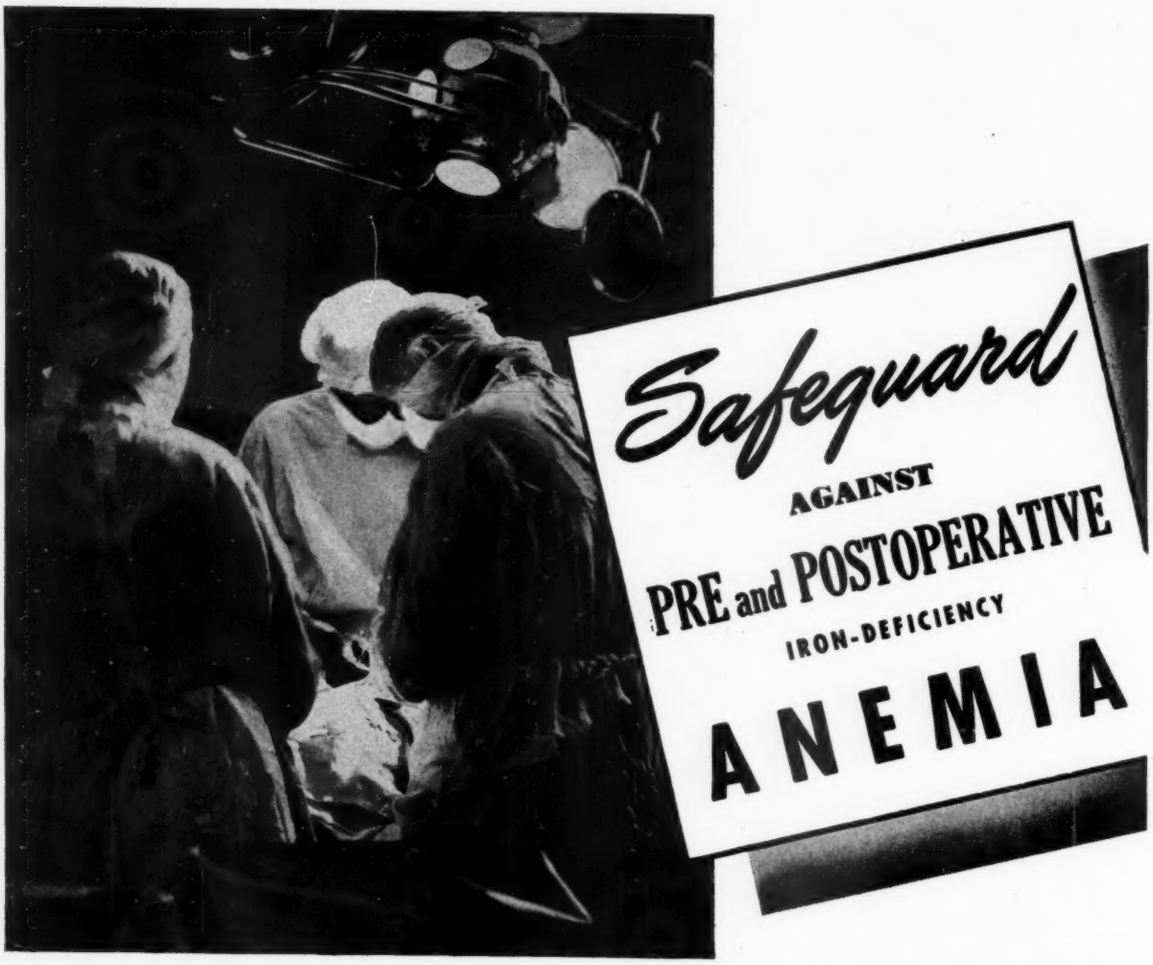
They don't believe *any* product is safe for intravenous injection—*unless* the tests say so. And they rig up tests for Saftiflask Solutions that a delicate vaccine would be proud to pass. Fact is, they borrow lots of their tricks from testing Cutter biologicals.

Result is, when they grant an "okay" to Saftiflask Solutions, it's only because try as they will, they can't find any more testing hoops to put them through.

For trouble-free performance, too, see what Saftiflask *simplicity* offers: Completely assembled equipment — no gadgets to fuss with. An air tube for quick starting and steady flow. The patented Safticlamp which provides one-thumb control of flow through tubing. For a demonstration, just call your Cutter representative.

CUTTER LABORATORIES

BERKELEY 1, CALIFORNIA

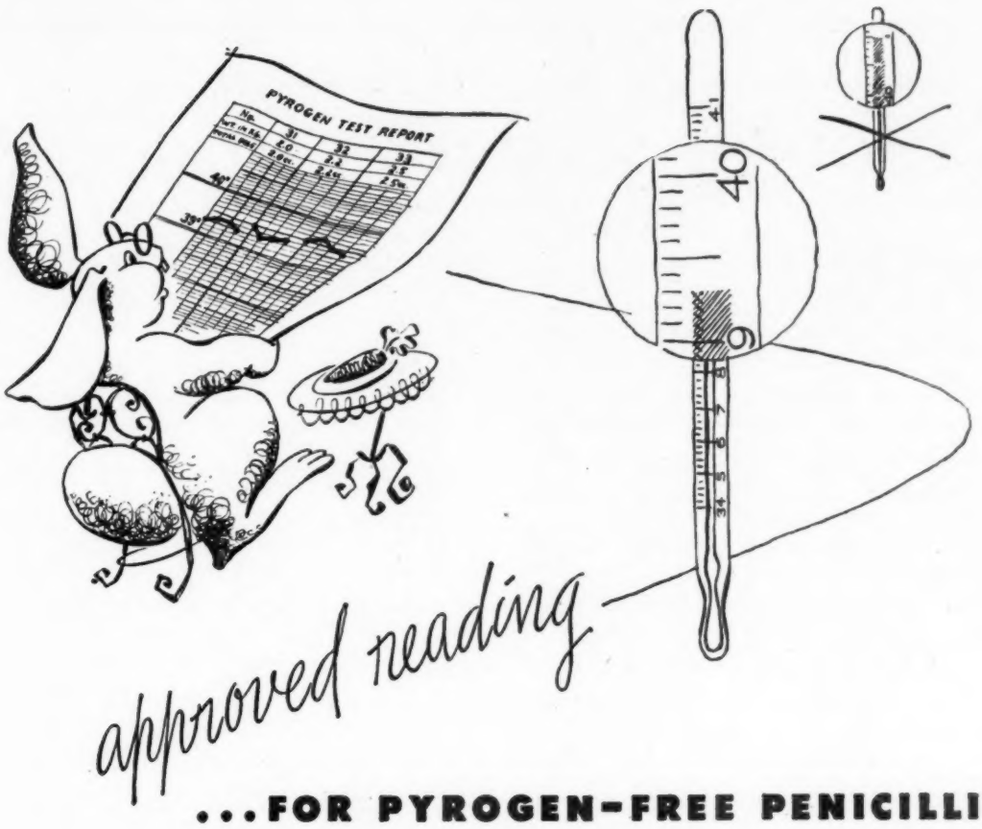


Iron-deficiency anemia is a factor to be considered in pre and postoperative conditions. Hence, we suggest that you prescribe Copperin routinely for a period preceding and following surgery. Copperin stimulates the hematopoietic system—provides material for replacement of hemoglobin—increases the red blood cell count.

Because in Copperin iron ammonium citrate is combined with the catalyst copper sulphate, there is a greater utilization of the iron by the system. For this reason the iron content per capsule is purposely small—32 Mgm. As there is no stomach irritation or constipating effect from Copperin, it is exceptionally well adapted to routine use. In two strengths: Copperin "A" for adults; Copperin "B" for children.

Liberal professional samples gladly sent on request

MYRON L. WALKER COMPANY, Inc.
Mount Vernon **New York**



approved reading

...FOR PYROGEN-FREE PENICILLIN

So that you may use it *with confidence*, Penicillin Abbott undergoes 138 separate tests in the course of production. These 138 Abbott tests, in addition to those conducted by the Food and Drug Administration, guard the product through every stage of manufacture. Besides pyrogens, the tests include mold contamination, potency, sterility, toxicity, penicillin G content, heat stability, pH, moisture content, solubility and crystallinity. They are your assurance that Abbott Penicillin Products are absolutely dependable—whether used for the preparation of solutions, for auxiliary care, or for other dental purposes. Your favorite source of supply has a convenient and varied stock—troches, tablets, vials, ointments, disposable syringes and cartridges. Interested in more information about Penicillin Abbott? A line to us will bring a prompt response. ABBOTT LABORATORIES, NORTH CHICAGO, ILLINOIS.

ABBOTT

Penicillin Products

Pyrogen Test—*one of the 138 separate tests made by Abbott in the production of dependable penicillin:* Each rabbit used must weigh at least 1500 Gm. and its temperature, taken just before each test, must register between 38.9° C. and 39.8° C. The penicillin being tested is dissolved in pyrogen-free distilled water and diluted to 2000 units per cc. This solution is injected intravenously into three rabbits, one cc. for each kilogram of body weight. After injection, the temperatures are recorded at one-hour intervals for three hours. If two or three of the rabbits show a rise of 0.6° C. or more in temperature, the penicillin is considered pyrogenic. If only one rabbit shows a rise of 0.6° C. or more, or if the sum of the temperature-rises of all three rabbits exceeds 1.4° C., the test must be repeated, using five rabbits. If two or more of the five show rises of 0.6° C. or more, the presence of pyrogens is confirmed, and the whole Penicillin lot must be reworked to eliminate the undesirable properties.

COOK COUNTY
GRADUATE SCHOOL OF MEDICINE

Announces continuous courses

SURGERY—Intensive Course in Surgical Technique, Two Weeks, Starting April 12, May 10, June 7.
Surgical Technique, Surgical Anatomy & Clinical Surgery, Four Weeks, Starting March 29, April 26, May 24.
Surgical Anatomy & Clinical Surgery, Two Weeks, Starting April 12, May 10.
Surgery of Colon & Rectum, One Week, Starting April 26, May 24.
Surgical Pathology Every Two Weeks.

FRACTURES & TRAUMATIC SURGERY—Intensive Course, Two Weeks, Starting June 7.

PEDIATRICS—Intensive Course, Four Weeks, Starting April 5.

GYNECOLOGY—Intensive Course, Two Weeks, Starting April 26, June 7.

OBSTETRICS—Intensive Course, Two Weeks, Starting April 12, June 21.

MEDICINE—Intensive Course, Two Weeks, Starting April 26.
Personal Course in Gastroscopy, Two Weeks, Starting March 29, April 19.
Electrocardiography & Heart Disease, Four Weeks, Starting May 3.

DERMATOLOGY—Formal Course, Two Weeks, Starting April 26.
Clinical Course Every Two Weeks.

GENERAL, INTENSIVE AND SPECIAL COURSES IN ALL BRANCHES OF MEDICINE, SURGERY AND THE SPECIALTIES

TEACHING FACULTY—ATTENDING STAFF
of Cook County Hospital

Address: Registrar, **427 South Honore Street, Chicago 12, Illinois**

THE NEW YORK POLYCLINIC
MEDICAL SCHOOL AND HOSPITAL

(ORGANIZED 1881)

(The Pioneer Post-Graduate Medical Institution in America)

OBSTETRICS AND GYNECOLOGY

A full time course. In Obstetrics: lectures; prenatal clinics; witnessing normal and operative deliveries; operative obstetrics (manikin). In Gynecology: lectures; touch clinics; witnessing operations; examination of patients pre-operatively; follow-up in wards post-operatively. Obstetrical and Gynecological pathology. Regional anesthesia. Attendance at conferences in Obstetrics and Gynecology. Operative Gynecology (cadaver).

FOR THE GENERAL SURGEON

A combined surgical course comprising general surgery, traumatic surgery, abdominal surgery, gastroenterology, proctology, gynecological surgery, urological surgery. Attendance at lectures, witnessing operations, examination of patients preoperatively and post-operatively and follow-up in the wards post-operatively. Pathology, roentgenology, physical therapy. Cadaver demonstrations in surgical anatomy, thoracic surgery, regional anesthesia. Operative surgery and operative gynecology on the cadaver.

PHYSICAL MEDICINE

Didactic lectures and active clinical application of all present-day methods of physical therapy in internal medicine, general and traumatic surgery, gynecology, urology, dermatology, neurology and pediatrics. Special demonstrations in minor electrosurgery, electrodiagnosis, fever therapy, hydrotherapy including colonic therapy, light therapy.

FOR THE GENERAL PRACTITIONER

Intensive full time instruction in those subjects which are of particular interest to the physician in general practice, consisting of clinics, lectures and demonstrations in the following departments—medicine, pediatrics, cardiology, arthritis, chest diseases, gastroenterology, diabetes, allergy, dermatology, neurology, minor surgery, clinical gynecology, proctology, peripheral vascular diseases, fractures, urology, otolaryngology, pathology, radiology. The class is expected to attend departmental and general conferences.

FOR INFORMATION ADDRESS

MEDICAL EXECUTIVE OFFICER, 345 West 50th Street, NEW YORK 19

(*continued from page 29*)

The Long Island College of Medicine (350 Henry St., Brooklyn 2, N.Y.) announces the forthcoming presentation of its **Fifth Postgraduate Course in Industrial Medicine.** This course will be given during the two-week period April 5 to April 16, 1948, and will be conducted under the auspices of the Department of Preventive Medicine and Community Health by a distinguished group of more than sixty leaders in industrial medicine, authorities in allied fields and members of the faculty.

This presentation continues the series of orientation courses in industrial medicine, begun by the College in the fall of 1942, which has gained national and international prominence in promoting the health of gainfully employed workers and their families. It will also be the initial undertaking of the new Institute for Occupational Health of the Long Island College of Medicine, a unit of the College recently established to devote particular attention to the problems of health in relation to occupation.

The main objective of the course is to provide physicians engaged in full time or part time industrial practice, as well as those who wish to enter this field, an opportunity to become acquainted with the most recent developments in the rapidly expanding specialty of industrial medicine. Although arranged primarily for graduate physicians, the course will be of special interest and value to industrial nurses, hygienists and engineers, personnel workers, representatives of management and labor, as well as to other professional and business groups concerned with the health of employed persons.

Dr. Neil P. Macphail, veteran surgeon and sanitarian of the United States Fruit Company at Quirigua, Guatemala, was awarded the Richard P. Strong palladium medal for **distinguished service in tropical medicine** at the annual dinner of the American Foundation for Tropical Medicine, held January 8th, at the Waldorf-Astoria, New York. Dr. Edward J. Salisbury, General Superintendent, Medical Department, United Fruit Company, made the presentation, fifth in the annual series, in behalf of Col. Richard Pearson Strong, U.S. Army Retired, and Professor Emeritus of Harvard Medical College.

In Helen Cookman's entirely new surgeon's uniform, the **Surgeon's Wash-Up Suit and Gown,** the soft grey-blue color, "calm" blue, is to reduce the glare from the conventional all-white gown. The fabric is Reeves Dixie poplin and is ideally suited because it is light in weight and yet withstands innumerable launderings. . . . The neck band of the gown has a bias fold, soft enough never to irritate the skin . . . and it flattens out to a V at the center back, so it is always firmly in place. . . . The high set sleeves at the shoulders with an unusually wide armhole provide remarkably free motion for the arms. . . . This is an entirely new feature for professional uniforms as it helps considerably to alleviate fatigue. . . . Another innovation are the long knitted wrist-sections, much longer than in conventional surgeon's gowns. These diminish the bulge in the upper sleeves, provide easier arm and hand movement and also enable getting into gloves easier. . . . In the back, the gown completely covers the underneath attire.

Tales and Details

Well, I guess that somebody read my first column. That measles story made a hit on my detail route, and I'm all set to carry on. Now all I need is a secretary—blonde, say—about 5'2"!!!

Figures! — that reminds me — I promised you a different kind from that 1935-1945 U.S. Public Health measles survey. Did you know that—

- the average measles season lasts 20 weeks
- 80% of the cases occur between the end of January and the middle of June
- 60% of these cases are concentrated in the 12-week period from March through May

Those figures pack a heavy case load into a few short months—particularly if some youngsters develop complications. That's where our Immune Serum Globulin comes in.

In measles serum it's the gamma globulin that counts. Cutter has 160 mgm. per cc. for low volume dosage with known antibody concentration. Besides, our human blood source is *venous*—so our serum is hemolysis-free, water clear, and no side reactions have been reported.

"No side reactions,"—Golly, what that must mean to a busy doctor! Take the time Tom, our oldest kid, brought measles home from school, exposing the baby and young Pete . . .

Here's what our doctor did — the baby got a preventive dose (0.1 cc. per pound body weight) to give her full protection. Tom and Pete were old enough to build their own permanent immunity—so they had the modification schedule, 0.02 cc., based on body weight. All safe—and easy on everybody, including the doctor.

That's it — see you next time.

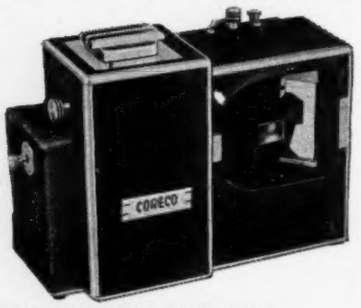
Your Cutter detail man

CUTTER LABORATORIES
Berkeley 1, California

Coreco —

THE ONLY COMPLETELY AUTOMATIC COLOR CAMERA

PRESS ONE BUTTON TO TAKE A PERFECT COLOR PICTURE OF ANY SURFACE OR CAVITY



THE ONLY CAMERA OF ITS KIND —
A COMPLETE PHOTOGRAPHIC DEPARTMENT

STANDARD APPLICATORS AVAILABLE FOR:

SURFACE (ALL AREAS)	GUMS
PORTRAIT	ANTERIOR TEETH
CERVIX	MOLARS
VULVA	SOFT PALATE
VAGINA	HARD PALATE
RECTUM SURFACE	BRIDGEWORK
ANUSCOPE	PLASTER MODELS
SIGMOIDUSCOPE	TONGUE
COPYING BRACKETS	EYE
THROAT	EAR
LARYNX	NOSE

Other applicators to meet your most exacting requirements.

It is now possible, using the "CORECO" Automatic Color Camera, Model 300, to establish a standard of photography where all photographic factors are constant at all times. This instrument offers: correct lens opening, critically sharp focus, correct and constant distance from lens to object and lens to film, exact size of field to be photographed, and a light source that is always constant. All these factors are so integrated and synchronized that *one* push button controls them all, and the only variable is the progression of the subject matter itself. No knowledge of photography is required for perfect operation of the camera. Here is the ideal instrument for color recording of clinical case histories and for research in many varied fields.

For further information, send your specific requirements to:

CORECO RESEARCH CORP.
1908 BROADWAY • NEW YORK 23, N. Y.

CONSTANT FACTORS ASSURE CONSTANT RESULTS

The Role of IODINE
in Clinical Diagnosis

• Diagnosis is the art or scientific process by which a disease is recognized. Success or failure in establishing a correct diagnosis depends in large measure on the use of reliable, safe and efficient clinical and laboratory procedures.

• Iodine compounds occupy a unique position as indispensable aids in providing X-ray evidence that is informative and most frequently complete. They supply the ideal contrast media for many diagnostic procedures — including bronchography, cholecystography, pyelography and myelography. Without these compounds, an accurate diagnosis might be difficult or impossible to make.

• Likewise in the fields of prevention and therapy. few medicaments serve such useful and varied purposes as Iodine with its many compounds and derivatives.

IODINE EDUCATIONAL BUREAU, INC.
120 BROADWAY • NEW YORK 5, N. Y.

Aloe

Suppliers of surgical equipment, instruments and supplies to the medical profession since 1860.

A. S. ALOE COMPANY • 1831 Olive Street, St. Louis 3, Missouri

A Better Nutritional Start For The Day

Despite the unanimous agreement among all nutritionists and dietitians that breakfast should provide from one-fourth to one-third of the daily caloric and nutrient needs, a large segment of our population fails to eat an adequate morning meal. Not only adults, but also children of school age are guilty of this practice which is bound to decrease morning acuity and stamina, and to impose an almost impossible burden upon the other two meals to overcome the deficit created.

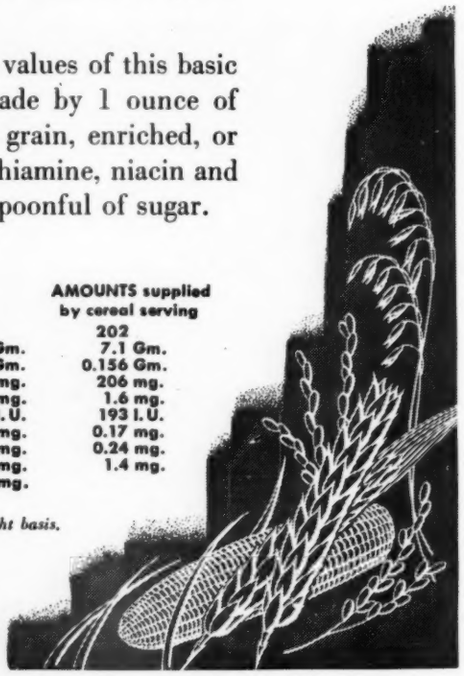
A widely endorsed basic breakfast pattern provides the foundation upon which a better nutritional start for the day can be built. Supplying fruit, cereal, milk, bread and butter, it contributes 611 calories and virtually all essential nutrients in generous amounts. The cereal serving, consisting of hot or ready-to-eat breakfast cereal, milk, and sugar, is the main dish of this meal. It supplies significant amounts of the nutrients provided by the breakfast, and adds both taste appeal and variety.

The table indicates the nutrient values of this basic breakfast and the contribution made by 1 ounce of ready-to-eat or hot cereal* (whole grain, enriched, or restored to whole grain values of thiamine, niacin and iron), 4 ounces of milk and 1 teaspoonful of sugar.

The presence of this seal indicates that all nutritional statements in this advertisement have been found acceptable by the Council on Foods and Nutrition of the American Medical Association.

BASIC BREAKFAST	TOTALS supplied by Basic Breakfast		AMOUNTS supplied by cereal serving
Orange juice, 4 oz.;			
Ready-to-eat or Hot Cereal, 1 oz.;	CALORIES	611	202
Whole Milk, 4 oz.;	PROTEIN	20.7 Gm.	7.1 Gm.
Sugar, 1 teaspoon;	CALCIUM	0.465 Gm.	0.156 Gm.
Toast (enriched, white), 2 slices;	PHOSPHORUS	488 mg.	206 mg.
Butter, 5 Gm. (about 1 teaspoon);	IRON	3 mg.	1.6 mg.
Whole Milk, 8 oz.	VITAMIN A	1074 I.U.	193 I.U.
	THIAMINE	0.52 mg.	0.17 mg.
	RIBOFLAVIN	0.87 mg.	0.24 mg.
	NIACIN	2.3 mg.	1.4 mg.
	ASCORBIC ACID	64.8 mg.	

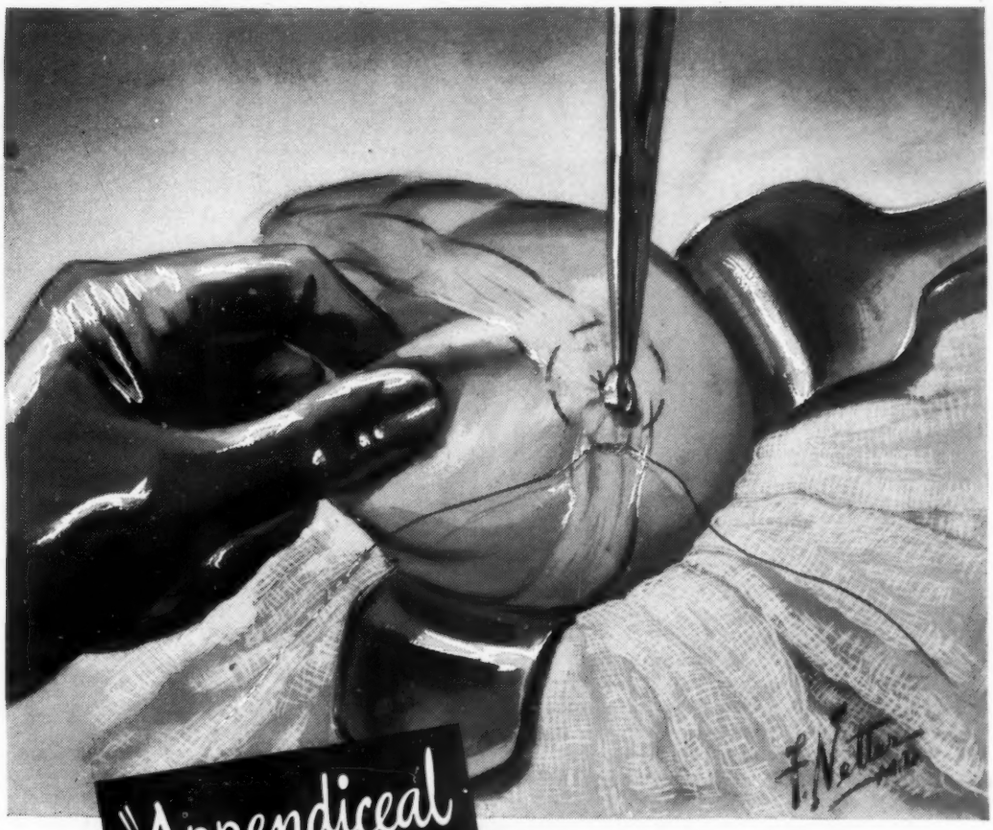
*Composite average of all breakfast cereals on dry weight basis.



CEREAL INSTITUTE, INC.

A research and educational endeavor devoted to the betterment of national nutrition.

135 South La Salle Street • Chicago 3



"Appendiceal Stump"

Some surgeons do and some do not bury the appendiceal stump. But all are agreed on the importance of making a firm, secure closure of that stump. In this as in other surgical procedures, security depends upon the quality of the ligature material employed as well as upon the technique of the operation. Armour suture and ligature materials help attain that security. Tensile strength, uniformity and absolute sterility are assured by the Armour process of fine suture making. Armour sutures too are noted for their good flexibility, pliability, elasticity . . . in short, for their excellent "workability." This quality makes for firm, secure knots and facilitates the surgeon's difficult task.

Good Surgery demands the best in Sutures and Ligatures—Specify "Armour"

SUTURE DIVISION, THE Armour LABORATORIES
1425 W. 42nd STREET
CHICAGO 9, ILLINOIS

another of its several advantages:

Furacin remains actively antibacterial

in vitro in the presence of such organic matter as blood, serum and bacterial debris[1,2,3]. when its minimal antibacterial concentrations are increased as from two to ten times. Results in vivo also demonstrate its effectiveness in the presence of wound exudates[4,5].

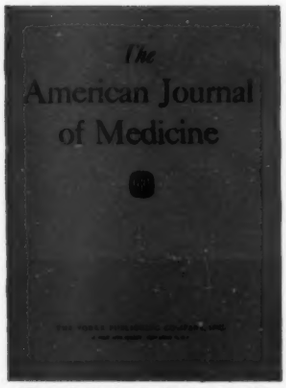
Indications

Infected surface wounds, or for the prevention of such infection
Infections of second and third degree burns
Carbuncles and abscesses after surgical intervention
Infected varicose ulcers
Infected superficial ulcers of diabetics
Impetigo of infants and adults
Treatment of skin-graft sites
Osteomyelitis associated with compound fractures
Secondary infections following dermatophytoses

EATON LABORATORIES Inc.
NORWICH, NEW YORK • TORONTO, CANADA

LITERATURE ON REQUEST

1. Dodd, M. C. & Stillman, W. B.: J. Pharmacol. & Exper. Therap. *82*:11, 1944 • **2.** Cramer, D. L. & Dodd, M. C.: J. Bact. *51*:293, 1946 • **3.** Dodd, M. C.: J. Pharmacol. & Exper. Therap. *86*:311, 1946 • **4.** Neter, E. & Lambarti, T. G.: Am. J. Surg. *72*:246, 1946 • **5.** Snyder, M. L., Kiehn, C. L. & Christopherson, J. W.: Mil. Surg. *97*:380, 1945.



Established July 1946

EDITORIAL BOARD

EDITOR

ALEXANDER B. GUTMAN, M.D.
Assistant Professor of Medicine, Columbia University, College of Physicians and Surgeons, New York

ADVISORY BOARD

WALTER W. PALMER, M.D., *Chairman*
Bard Professor Emeritus of Medicine, Columbia University, College of Physicians and Surgeons, New York
DAVID P. BARR, M.D.
Professor of Medicine, Cornell University Medical College, New York
FRANCIS G. BLAKE, M.D.
Sterling Professor of Medicine, Yale University of Medicine, New Haven
ARTHUR L. BLOOMFIELD, M.D.
Professor of Medicine, School of Medicine, Stanford University, San Francisco
EUGENE A. STEAD, JR., M.D.
Professor of Medicine, School of Medicine, Duke University, Durham
JOSEPH T. WEARN, M.D.
Professor of Medicine, School of Medicine, Western Reserve University, Cleveland

ASSOCIATE EDITORS

HERRMAN L. BLUMGART, M.D., Boston
HARRY GOLD, M.D., New York
A. MCGEHEE HARVEY, M.D., Baltimore
GEORGE H. HOUCK, M.D., San Francisco
CHESTER S. KEEFER, M.D., Boston
T. GRIER MILLER, M.D., Philadelphia
WALTER L. PALMER, M.D., Chicago
OSWALD H. ROBERTSON, M.D., Chicago
EPHRAIM SHORR, M.D., New York
GEORGE W. THORNE, M.D., Boston
WILLIAM S. TILLETT, M.D., New York
ROY H. TURNER, M.D., New Orleans
RUSSELL M. WILDER, M.D., Rochester, Minn.
M. M. WINTROBE, M.D., Salt Lake City
W. BARRY WOOD, M.D., St. Louis
JOHN B. YOUMANS, M.D., Chicago

A LEADER FOR LEADERS!

It's new, it's up to date, it's authoritative. Many doctors say, "The finest medical journal in America."

In this 200-page Journal, you will find the very latest in early researches and findings—evaluations of present-day practice by the most eminent authorities; twenty-four Staff Conferences from Cornell Medical School, College of Physicians & Surgeons and The George Washington University School of Medicine; reviews; seminars and symposia.

Here is a medical journal you'll enjoy reading. The printing is limited. Subscribe today!

THE YORKE PUBLISHING CO., INC.
also publishers The American Journal of Surgery

SUBSCRIPTION ORDER FORM

THE AMERICAN JOURNAL OF MEDICINE
49 WEST 45TH STREET, NEW YORK 19, N. Y.

Please enter my subscription to the new monthly journal, THE AMERICAN JOURNAL OF MEDICINE. Subscription U.S.A. $10.00 per year. $15.00 Foreign.

NAME_____ ADDRESS_____

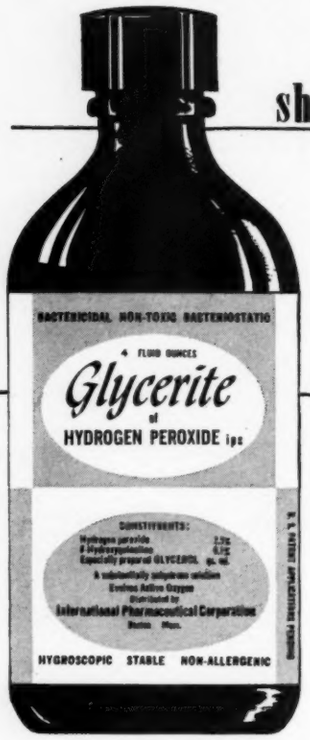
CITY_____ STATE_____

rapid control!

In POST-OPERATIVE and TRAUMATIC INFECTIONS

shortens healing time!

aids exudation!



promotes granulation tissue!

Clinical studies:

In a series of 94 patients treated post-operatively with **Glycerite of Hydrogen Peroxide ipc** for ***hemorrhoidectomies, fistulectomies, excisions of anal ulcers, abdomino-perineal resections, and pelvi-rectal abscesses*** demonstrated healing in **one half the time** required by a control series of patients treated by the usual therapeutic means . . .

Apply directly, or as a wet dressing, two—four times daily. Supplied in four-ounce bottles.

GLYCERITE OF HYDROGEN PEROXIDE *ipc*

Non-selective. Non-toxic. Non-sensitizing. Non-irritating. Prolonged bactericidal potency

Bibliography: *New Eng. J. Med. 234:468, 1946. J. Invest. Derm. 8:11, 1947. Science 105:312, 1947. Am. J. Surgery 74:428, 1947*

Literature on request.

International PHARMACEUTICAL CORPORATION

132 Newbury Street, Boston 16, Massachusetts

Crystalline Penicillin G Sodium Merck is now supplied in vials with a new, improved aluminum seal.

Among the advantages provided by this new seal are:

- The round tear-off tab is easily removable and eliminates the necessity of using a knife or other implement to pry up the tab.
- The tight-fitting dust cap with skirt provides protection for the rubber stopper during storage of the vial between injections.

Crystalline Penicillin G Sodium Merck is a highly purified product from which therapeutically inert materials have been virtually eliminated.

For Penicillin of the highest quality—
SPECIFY MERCK!

CRYSTALLINE
PENICILLIN G SODIUM
MERCK

MERCK & CO., Inc. RAHWAY, N. J.

Manufacturing Chemists

MERCK
MERCK

FOR COMPLETENESS AND CONVENIENCE WHEN PRESCRIBING FOR CONCEPTION CONTROL

Ortho-Gynol Set

This compact, attractive package contains: (1) a tube of Ortho-Gynol Vaginal Jelly—the most widely prescribed contraceptive preparation—with (2) a high-quality Ortho Diaphragm (sizes 55 to 95mm), and (3) a non-breakable, transparent, plastic Ortho Diaphragm Introducer. (For those preferring a cream, Ortho Set is also available with Ortho Creme in place of Ortho-Gynol Vaginal Jelly.)

Thus with *one* prescription, patients in whom pregnancy is contraindicated may be provided with a highly reliable spermicide . . . the added assurance of a correctly fitted diaphragm . . . and the means for its easy insertion.

gredients:
c acid 0.7%,
d 3.0%, and
line sulfate

harmaceutical Corporation • Raritan, New Jersey

Makers of Gynecic Pharmaceuticals

ARMACEUTICAL CORPORATION

The American Journal of Surgery

ADVERTISERS INDEX

Instruments and Apparatus

A. S. Aloe Company 39
American Cystoscope Makers, Inc 14
Bard-Parker Co., Inc ..... *Febr.*
Becton, Dickinson & Co 20
Clay-Adams Co., Inc 18
Coreco Research Corp 38
Crescent Surgical Sales Co 28
Gomco Surgical Mfg. Co ..... *Febr.*
J. E. Hanger, Inc 30
Fred Haslam & Co., Inc 30
The Kansas City Assemblage Co ..... *Febr.*
Kny-Scheerer Corp 12
Parker, White & Heyl, Inc ..... *Febr.*
Geo. P. Pilling & Son Co 11
J. Sklar Manufacturing Co ..... *Febr.*
Wallace Orthopedic Supply Co 10
Edward Weck & Co., Inc 13
Wilmot Castle Co 15

Sutures

The Armour Laboratories 41
Bauer & Black 8–9
Davis & Geck, Inc ..... *Insert Facing 2nd Cover*
J. A. Deknatel & Sons, Inc 28
Ethicon Suture Laboratories 32
Gudebrod Brothers Silk Co 22

Pharmaceuticals

Abbott Laboratories 35
American Hospital Supply Corp 7
The Armour Laboratories 41
Baxter Laboratories 7
Bilhuber-Knoll Corp 26
Bristol Laboratories 1
Chatham Pharmaceuticals, Inc ..... *Febr.*
Ciba Pharmaceutical Products, Inc ..... *Back Cover*
Commercial Solvents Corporation ..... *Febr.*
Cutter Laboratories 33, 38
Eaton Laboratories 42
E. Fougera & Co., Inc ..... *Febr.*
International Pharmaceutical Corp 44
Iodine Educational Bureau, Inc 39
Lanteen Medical Laboratories, Inc ..... *Febr.*
Eli Lilly and Company 2
Medicone Co 19
Merck & Company 45
National Drug Co ..... *Febr.*
Ortho Pharmaceutical Corp 46
Parke, Davis & Co ..... *Febr.*
Rystan Company 25
Schering Corporation 21
Sharp & Dohme, Inc 23
E. R. Squibb & Sons ..... *Febr.*
The Upjohn Company ..... *Febr.*
The Vodine Co 31
Myron L. Walker Co., Inc 34
White Laboratories, Inc 16–17
Winthrop-Stearns, Inc 4

Hospital Supplies

A. S. Aloe Company 39
American Hospital Supply Corp 7
Becton, Dickinson & Co 20
Cutter Laboratories 33, 38
Fred Haslam & Co., Inc 30
Johnson & Johnson ..... *Febr.*
Mallinckrodt Chemical Works ..... *Febr.*
The Pioneer Rubber Co 26
J. Sklar Manufacturing Co ..... *Febr.*

Post-Graduate Instruction

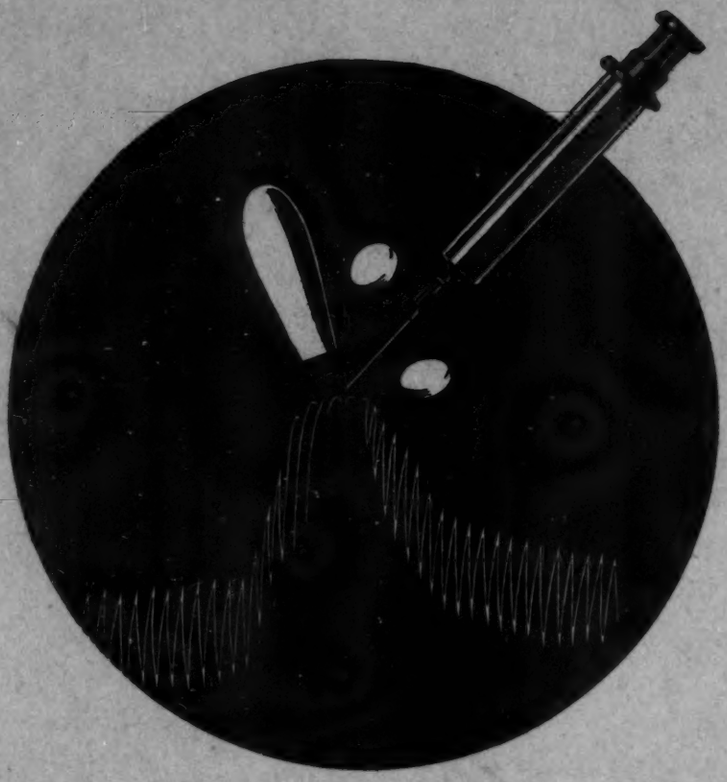
Cook County Grad. Sch. of Med 36
N. Y. Polyclinic Med. School 36

Foods

American Meat Institute ..... *Febr.*
Cereal Institute Inc 40
National Confectioners' Assn ..... *Febr.*
The Wander Company 24

Miscellaneous

The American Journal of Medicine 43
Outside the Ivory Tower 27



FOR SELECTIVE RELIEF OF SMOOTH MUSCLE SPASM

TRASENTINE • Trasentine-Phenobarbital

In the field of antispasmodics, Trasentine has earned a leading position because in therapeutic dosage, it selectively blocks parasympathetic impulses to the hollow viscera, without causing drying of the mouth or pupillary dilatation. This spasmolytic effect is reinforced by a direct inhibitory action on smooth muscle.

Trasentine is available in forms to meet every need, as listed below—including a compound with phenobarbital.

ISSUED------Trasentine tablets 75 mg., ampuls 50 mg., suppositories 100 mg.

Trasentine-Phenobarbital tablets contain Trasentine 50 mg., Phenobarbital 20 mg.

Ciba PHARMACEUTICAL PRODUCTS, INC., SUMMIT, NEW JERSEY

2/1336M

TRASENTINE (brand of adiphenine) • T.M. Reg. U. S. Pat. Off.